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LETCHER HAMILTON

State Mineralogist

San Francisco]

BULLETIN No. 76

[August, 1918

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Manganese and Chromium

In

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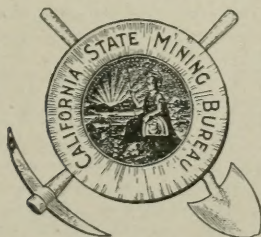
In

California

By

WALTER W. BRADLEY, EMILE HUGUENIN, C. A. LOGAN,

W. BURLING TUCKER and CLARENCE A. WARING.

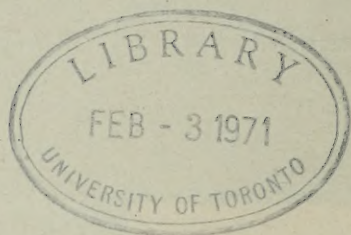


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LETTER OF TRANSMITTAL.

To His Excellency, the HONORABLE WILLIAM D. STEPHENS,
Governor of California.

SIR: AS stated under date of October 15, 1917, in transmitting Preliminary Report No. 3 on Manganese and Chromium, there is a serious shortage of these metals in the United States at the present time. As they are both vitally necessary in the steel industry, their adequate production has become a matter of no little concern from the standpoint of the successful completion of the war in which the Nation is now engaged.

The contents of the accompanying bulletin represent the labors of five trained field assistants of this Bureau, who were delegated to carry on this work early in the summer of 1917. These data make up an inventory of California's manganese and chrome resources, and an attempt has been made to set forth facts relative to the location of all deposits of these metals and to present information which will assist in making them available for early development and utilization. It is believed that material assistance will be hereby rendered to the government of the United States, as well as to all of the parties interested in the development of this branch of the mining industry in California.

Respectfully submitted.

August, 1918.

FLETCHER HAMILTON,
State Mineralogist.

FOREWORD.

The occurrence of manganese and chromium ores in California has long been known, and a small production of each has been reported to the State Mining Bureau since as early as 1887.¹ Previous to the war with Germany, however, the necessary supplies of these materials which are mainly utilized in the steel producing centers of the East, were imported from foreign sources at a cost which made competition by California producers impossible because of the long railroad haul and the high freight rate from the Pacific coast.

Foreign supplies are now considerably curtailed, however, and sources which might otherwise be available are reached with difficulty on account of lack of ocean transportation.² As a result, the search for manganese and chromium, not only in California, but in other sections of the United States, has been carried on in a manner unprecedented in the history of the Nation.

As the production of a sufficient supply of these minerals is not only important to the development of the mining industry of this state, but has assumed the position of a national necessity, the Bureau has made every effort to correlate the following data in the most efficient manner possible, without undue loss of time in making the report available. The subject matter is offered in two parts, Part I being devoted to Manganese and Part II to Chromium, and these divisions have been further subdivided into chapters according to the various counties in which deposits of these minerals occur, arranged alphabetically for convenience in reference.

C. A. Waring visited the properties in the Sierra Nevada mountain counties; W. B. Tucker covered the district south of the Sixth Standard Parallel; and E. Huguenin visited many Coast Range properties. The other authors visited many widely separated properties between San Luis Obispo County and the Oregon line.

ACKNOWLEDGMENT.

Uniform courtesy was extended to the various field assistants engaged in this work by owners and operators of mines throughout the state, and grateful acknowledgment is hereby made for this co-operation, without which satisfactory results could not possibly have been attained.

Assistance has been received from various members of the U. S. Bureau of Mines and the U. S. Geological Survey by exchange of various

¹For tables of annual production of these minerals, see pp. 100 and 226, *post*.

²See supplementary statement on p. 227, *post*, relative to late break in the chromite market.

data relative to the subject in hand, and it is a pleasure to hereby acknowledge the aid thus received.

Notes kindly furnished by members of the staff of the Department of Geology of the University of California have helped to make the report on manganese more comprehensive than would otherwise have been possible. Special thanks in this connection are due Professor Geo. D. Louderback and his assistants, Messrs. E. F. Davis, F. L. Hudson and N. H. Taliaferro.

PART I.

MANGANESE.

INTRODUCTION.

By C. A. LOGAN.

Uses of Manganese and Grades of Ore Required.

The paramount use for the metal, which overshadows all other requirements, is in steel making. In small percentage manganese serves to remove sulphur and oxygen, preventing brittleness and eliminating "blow holes." In larger percentage as a constituent of the steel, it imparts toughness and hardness. Two classes of manganese-iron alloys are made for use in steel. Ferro-manganese contains 70% to 80% manganese, 15% to 20% iron and 5% or 6% carbon. A high grade manganese ore, containing preferably 45% or more of manganese, not over .225% phosphorus and as little silica, iron and other impurities as possible, is desired in making it, but ore carrying less than 40% manganese can be used, and if the metallic manganese content is high enough, as much as 25% silica is accepted subject to penalty for each per cent of silica over 8%. Makers of ferro-manganese by the electric smelting method can use ore lower in manganese and higher in silica than can others; Noble Electric Steel Co.¹ stated under date of April 27, 1918, that they could use certain ores carrying as low as 36% Mn, with silica not over $\frac{1}{2}$ the metallic manganese content, and iron not over 10%. Where the silica content is under 8% and 5% a bonus of 50¢ to \$1 a ton is quoted. For making spiegel-eisen, lower grade ore is allowable. This alloy carries 15% to 20% manganese, about 5% carbon and the balance chiefly iron; any ore which gives these proportions and is not otherwise objectionable may be used. Ores as low as 5% Mn are used in "high manganese" pig iron. Ores of less than 35% Mn content are classed as low grade, or as manganiferous iron or silver ore, as the case may be. Such ores are produced annually in this country to the extent of about 1,000,000 tons, of which 6% to 8% contains over 15% manganese. The June, 1918, production of ferro-manganese was 29,568 long tons and of spiegeleisen, 16,398 tons, according to Iron Age. Efforts are being made to have manufacturers make spiegeleisen as much as possible. Noble Electric Steel Company was making ferro-manganese in California in June at the rate of 1,000,000 pounds a month, utilizing ores from California mines.

¹Cal. State Min. Bur.; Preliminary Rep. 3, 1918.

For making dry batteries over 20,000 tons of high-grade ore are reported annually consumed in this country. Specifications for this use call for a high content of available oxygen, which is not always found with a high metallic manganese content. The content of manganese dioxide should be 80% or more. Any other mineral is of no use. Cobalt, nickel and copper are harmful even in the smallest quantity, and more than 2% iron is not wanted, although not proven objectionable. For glass making an ore of similar tenor to the above is required. Pyrolusite is the best ore for such uses.

Smaller quantities of manganese are used to make pigments in paint, coloring for pottery, in varnish and as a drier in paints, for medicinal uses and for fertilizers. Manganese bronze is used in making ship propellers because of the resistance to corrosion by sea water.

The price established May 29, 1918, by the government for manganese ore containing 35% to 54% metallic manganese is from 86¢ to \$1.30 a unit (one per cent), f. o. b. South Chicago. A penalty of 50¢ to \$1 a ton is levied for excess silica above 8% up to 25%, with a corresponding bonus for ore carrying less than 8% silica. The other impurities which are objectionable in manganese ores for metallurgical use are absent from California ore, or present in such small quantity as to be negligible.

SOURCES OF WORLD'S MANGANESE.

Production of manganese ores in California has been effectually prevented in the past by cost of mining, prohibitive cost of delivering ore at the market and character of our local deposits, which have seldom appeared of sufficient size or grade to warrant expensive development. These conditions under which the domestic producer labors will be made clearer by brief consideration of the chief producers abroad.

Manganese in Russia.

The principal district is in the government of Kutais, near the village of Chiaturi on the southwest side of the Caucasus Mountains.² The ore occurs as a bedded deposit in brown Miocene sandstone, which lies nearly horizontal. The ore has been opened on seven mountains which are residual spurs left by Kvrilli River and its tributaries. The total mineralized area is said to be 55 square miles, of which 22 square miles are underlain by available ore. A thickness of six or seven feet is mined. The ore reserve was estimated by Drake to be at least 80,000,000 long tons, and it was being mined in 1913 at the rate of about 1,000,000 long tons yearly. The chief ore is pyrolusite.

²Drake, Frank, Manganese ore industry of the Caucasus; Trans. A. I. M. E., vol. 28, 1898.

which powders excessively in course of shipment. Ore is often intercalated with the sandstone. The product exported runs from 46% to 56% Mn, .16% phosphorus, and less than 8% silica. Miners received 40¢ a day. Ore is extracted by drifting on the bed and pillars are left with little timber and no powder required. Ore cost 92¢ a ton at mine portal, but outrageous transportation conditions between the mines and the coast brought the cost to nearly \$10 a ton delivered at English ports.

Deposits in India.³

Harder cites nine localities in India where manganese occurs. Practically all the important deposits are said to be in pre-Paleozoic metamorphic rocks. The ores are usually interlayered with quartzite and are of good grade, carrying 42%⁴ to 54% Mn, 4% to 10% silica and generally not over .3% P. Production up to the beginning of the war reached nearly 700,000 long tons a year.

Deposits in Brazil.

Since the opening of the war the production of manganese in Brazil has probably doubled, the figure for 1915 being 350,000 tons.⁵

In 1915, nine-tenths of the manganese imported into the United States came from Brazil. The Lafayette District is the most productive field, and the Morro da Mina property the largest producer. This mine yielded 200,000 tons in 1915, and is said to have a proven ore reserve of 10,000,000 tons. The ore is chiefly psilomelane and is the residual product of decomposition of an original manganiferous rock made up of varying proportions of manganese carbonate and silicates.⁶ The average composition of ore is said to be 50.47% Mn, .069% P, 1.76% SiO₂.

Other Foreign Deposits.

During the period of 20 years ending in 1905 considerable manganese ore was shipped to this country from Chile. E. C. Harder⁷ gives the amount as over 500,000 tons. This ore was driven off the market by the opening of deposits in India. The Chilean deposits, as described by Harder, appear in most respects similar to our own Coast Range deposits; they are relatively narrow ore-bodies in chert which is of approximately the same age as the Franciscan of California.

The richest cargo of manganese ore received in the United States is said to have been a shipload of 1400 tons shipped in 1896 from the

³Trans. A. I. M. E. 1917, p. 40.

⁴L. L. Fermor: Manganese Ore Deposits of India. Memoirs, Geol. Sur. India, Vol. 37. Brazil: Trans. A. I. M. E., 1917.

⁵Singewald and Miller, The manganese ores of the Lafayette district, Minas Geraes,

⁶Singewald and Miller, Opus cit. page 18.

⁷Manganese Ores of Russia, India, Brazil and Chile. Trans. A. I. M. E. 1917.

Nispero and Soledad mines in Panama.⁸ It averaged 57.5% Mn, 4.18% SiO₂ and .054% P. The deposits are in pockets, sometimes containing as much as 500 tons of ore, and lying in clay, which is said to be the result of decomposition in place of the original sedimentary rock.

Deposits in the United States.

Harder⁹ characterizes the deposits of manganese in this country as largely secondary concentration deposits. The deposits in the Coast Ranges of California do not belong in this category, as will be indicated later.

The principal geological horizons in which manganese occurs in the United States are the Cambrian, Silurian and Carboniferous. The original deposition of the manganese is held to have occurred in still water, usually in association with limestones and shales. The decomposition of these rocks to clays was accompanied by the concentration of the manganese in nodules and pockets. This applies to the deposits in Virginia, Georgia, Vermont and Arkansas, as well as to Canadian deposits in Nova Scotia and New Brunswick.

In the present paper these deposits may be dismissed with the statement that California leads the other states in the production of manganese ore as far as available statistics indicate. It must be remembered, of course, that there is a large amount of mangiferous iron ore produced in the Lake Superior iron regions which is utilized.

Another source of supply will be the low-grade ore taken from the mines at Butte, Montana. The Anaconda Copper Company plans to utilize buildings and machinery already available, and newly developed electric power, for the manufacture of ferro-manganese. Production is expected to begin early in September, 1918.

A surprisingly high percentage of manganese is carried by steel slags. Samples of six slags turned out by American steel makers carried from 2.5% to 50% manganese oxide. The highest percentage was from manganese steel slag from converters, but basic open hearth and bessemer slags carried as much as 22%, and one large maker of steel and pig iron claims to recover regularly 10.5% of manganese from open hearth slag.¹⁰ This slag is now being utilized in increasing quantity by makers of ferro-manganese.

⁸Chibas, E. J., Manganese deposits of the Department of Panama, etc.: Trans. A. I. M. E., vol. 27.

⁹Harder, E. C., Manganese deposits of the United States: U. S. Geol. Surv., Bull. 427, 1910.

¹⁰Mining and Scientific Press, April 6, 1918.

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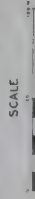
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CALIFORNIA STATE MINING BUREAU
BY FITCHER HAMILTON
STATE MINERALOGIST

OUTLINE MAP

OF

CALIFORNIA



SHOWING
LOCATIONS
OF

CHROMIUM & MANGANESE DEPOSITS

• Chromium • Manganese

DECEMBER

1917

O R E G O N



M E X I C O

DISTRIBUTION OF MANGANESE DEPOSITS IN CALIFORNIA.

Manganese ores have been reported in 36 counties of the State, and commercial production has been made so far from two-thirds of these. The three principal districts, which are distinct geologically as well as geographically, are the Coast Range Belt, the Sierra Nevada Counties and the southern desert region. The Klamath Mountain region also has many prospects which have been undeveloped on account of their remoteness, but even here mining has begun and production is expected from Siskiyou County in 1918.

Coast Range Deposits.

Manganese oxides occur in this belt invariably in the Franciscan chert and there is a monotonous similarity in the deposits from one end of the belt to the other. The variations in size of ore bodies are generally small, and may be ascribed to local causes. Manganese in greater or less amount is present throughout the whole extent of these Franciscan rocks, appearing often as small bunches, minute veins or possibly only as stains. In addition to this multitude of occurrences which possess no commercial value, the Coast Range Belt contains our best manganese mines.

Geology of Coast Range Deposits.

Manganese in the Franciscan cherts has evidently been deposited from solution simultaneously with the deposition of the cherty material, which occurred either in quiet water a long way from shore, or from siliceous springs. Harder's theory¹¹ that the manganese oxides are a replacement of the jasper is now considered untenable. The manganese ore was laid down as interstratified bodies enclosed in the chert, and has not migrated (except in a very minor way, as noted later) from place, nor has it replaced the jasper. The original manganese carbonate or silicate has been altered in situ to oxide by the action of ground water and other terrestrial agents, apparently. The only mine so far opened to the limit of ground water shows the oxide ores running into carbonate, and carbonate ore has also been noted above the limit of ground water, for example at the Mount Sanhedrin claims in Mendocino County. The silicate, rhodonite, is not reported from the Coast Ranges; the siliceous manganese ores so far found are not yet proven to be definite manganese silicates and have not been definitely named. The ore of shipping grade merges gradually into the siliceous wall rock without definite lines of separation. The wall surrounding the ore is often stained black, and this stained chert is very deceiving to the uninitiated prospector, who is led to think he has a larger ore body than is usually the case. The weight of the

¹¹Harder, E. C., Manganese deposits of the United States: U. S. Geol. Surv. Bull. 427, 1910.

hand specimen, the luster, hardness, manner of fracturing, and color of the streak left when the specimen is scratched by steel, are distinguishing characteristics.

Psilomelane is the chief mineral in ore of higher grade. This mineral has an unmistakable bluish black color when of good grade. It is scratched with difficulty by steel and has a shiny, dark streak. It occurs massive, is very heavy and has a conchoidal fracture. It does not have a definite composition and in the California deposits always has one or both of the softer oxides, pyrolusite and wad, associated with it, as powdery fillings in seams and cavities. One mine in San Luis Obispo County is producing hausmannite. This is chocolate brown, has a rusty yellowish brown streak, granular structure, and hardness of 5.5. It is an anhydrous oxide, Mn_3O_4 , which changes by hydration to psilomelane. California oxide ore is seldom crystalline or of definite chemical composition, and the application of a mineral name to it can only be approximate. Louderback¹² states that iron rarely exceeds 2% in Coast Range ore; phosphorus and sulphur are either very low or absent, and silica is apt to run from 10% to 20% in ores which carry 40% to 45% manganese. The latter is the only impurity causing any difficulty, and of course is of constant occurrence.

The cases where manganese oxide occurs deposited secondarily from solution after migration through cracks, fault planes or along contacts, are of no importance in our Coast Range deposits. Sometimes the multitude of tiny cross fractures in thin-bedded chert have been traversed by ground water, carrying manganese oxide which was deposited as a very thin, evenly distributed film on all the surfaces of the chert.

Southern Coast Counties.

Santa Barbara County has some small, remote prospects about ten miles from Los Olivos where a few tons of ore are reported, but no shipments have been made yet.

In San Luis Obispo County lenses of chert occur at frequent intervals in the Franciscan area which traverses the Los Osos Mountains, lying between San Luis Obispo and the Coast. Manganese occurs in most of these lenses and two properties have lately been opened which are producing the highest grade ore being marketed from the State. These properties are the southernmost of the prospects so far reported, but the chert lenses are also of frequent occurrence throughout the Franciscan belt which strikes northwest across the entire county on the west slope of the Santa Lucia Range, and no reason is known why

¹²Louderback, G. D., California manganese problem: Mining and Scientific Press, March 30, 1918.

the productive area for manganese should not be extended by prospecting. The two properties which are producing are 8 and 10 miles, respectively, from San Luis Obispo, the shipping point, and ore is hauled down grade all the way in auto trucks. Near the surface the ore was psilomelane chiefly, but at depth is proving to be hausmannite, the anhydrous oxide Mn_3O_4 . Recently the rate of production from one of these properties was reported to be six to seven cars monthly, and production has also begun on the other property. The best carload from the Staneuch deposit carried 78.1% MnO_2 . (See description under San Luis Obispo County for complete analysis.)

Other prospects have been noted at several places on the west slope of the Santa Lucia Range, but no work has been done yet on any of these. Some of them have been turned down on the strength of analyses of samples taken from the outcrop. This is poor practice, to say the least. The opening of the two good properties in the Prefumo Canon District seems ample incentive for a closer investigation of other known prospects in the county, as well as for new prospecting which may reveal additional possibilities.

The Franciscan area extending northwestward into Monterey County traverses a rough and sparsely settled district along the coast, where only one prospect had been reported to date.

Counties West of San Joaquin Valley.

Franciscan rocks form the upper portions of the Diablo Range, which extends northwestward along the line between San Benito and Merced Counties. These Franciscan rocks cover also the eastern hilly portions of Santa Clara and Alameda Counties, the southwest corner of San Joaquin and the western part of Stanislaus. All these counties have producing manganese mines or promising prospects. These properties are geologically similar in all respects to the other Coast Range deposits.

Production has been made to date from only one of the properties in San Benito and Merced Counties. This is the Hendricks Mine, 21 miles east of Tres Pinos. Other prospects in the district are best reached by road from that town, which is the railroad terminal. They lie along the summit of the range at distances of from 18 to 30 miles from the town and in most cases would require some road building before ore could be taken out. Aside from this, roads are good and favor traffic to Tres Pinos. The Briggs Mine, 26 miles from town, makes a promising showing. Other prospects have been leased lately. The climate is very mild here and rainfall is light, offering only temporary interruption to work or hauling.

The manganese properties of Santa Clara, Alameda, San Joaquin and Stanislaus Counties are grouped in a rather small area where the four counties corner in rough, hilly country.

Livermore is the shipping point for most of the properties in Santa Clara County, but a narrow gauge railroad from Patterson runs near some of them. The total production from this county for the past two years has been about 800 tons from seven properties. The haul to Livermore ranges from 25 to 35 miles. The Patterson and Western railroad offers facilities which have stimulated prospecting near its western terminus, but production has been small there so far.

Production from Alameda County in 1916 and 1917 totalled about 1700 tons, taken largely from two or three properties on Man Ridge, while smaller yield was made by several others. The properties lie from 9 to 22 miles southeast of Livermore. Rainy weather in the higher sections interrupts hauling.

The largest producer and the pioneer in manganese mining in the State is the Ladd Mine in San Joaquin County. Total production here to date has been over 15,000 tons and there is still a good reserve of ore. Except for its size, this property is not considered different geologically from other Coast Range deposits. It is the only one in the State equipped with crushing and screening machinery. Just south and east of the Ladd Mine a large lens of manganese ore produced about 3000 tons in 1916. These properties are two to three miles from Manganese Station on the Western Pacific Railway. Both are maintaining a satisfactory output.

Stanislaus County's production has been about 1000 tons in the past two years, and has been chiefly from two properties. Vernalis, the principal shipping point, is 14 or 15 miles distant. Some new development is promised from properties on Mt. Oso, and the outlook is generally good for augmented production in 1918.

Coast Ranges North of San Francisco Bay.

This group includes Marin, Sonoma, Napa, Lake, Mendocino and part of Humboldt Counties. Lake and Sonoma have yielded a few hundred tons. Mendocino was the leading producer in the State in 1915, with nearly 3000 tons reported, second in 1916 with over 1700 tons, and third in 1917, with over 1500 tons. Most of this ore has come from two properties: the Thomas Mine, and the Foster Mountain Mine. Ore from the former is hauled 6 miles to Redwood Station at a cost of \$3.00 a ton; from the latter, a 14 mile haul to Willits costs \$7.00 a ton. Remoteness from transportation hinders the development of many other properties. Among these may be mentioned the prospects on Mt. Sanhedrin, 25 miles east of Willits, where both oxide

and carbonate ores have been found. Two deposits in Humboldt County began production in June, 1918. Ore is hauled to Carlotta and Ft. Seward, and several carloads are said to have been shipped already. There are a few undeveloped manganese prospects 3 or 4 miles from the railroad in the southwestern part of Trinity County which properly belong in the Coast Range province. One had produced a carload of ore up to the end of 1917.

Klamath Mountain Region.

This includes parts of Trinity, Siskiyou and Shasta Counties. The properties in Trinity County are about 71 miles from the railroad at Redding, and remote from the wagon road. Some prospecting has been done on two of them, but enough ore has not yet been developed to justify the necessary 13 or 14 miles of road to Wildwood. One property, the Caudwell Prospect, is promising and is being prospected this season. Most of the manganese prospects in Siskiyou County are as far from transportation as are those in Trinity. There is a promising prospect near Sawyer's Bar, which is separated from the railroad by a 53-mile haul over a divide about 6000 feet high. The writer also noted several outcrops of siliceous black oxides, superficially of low grade and undeveloped, on the Blue Ridge between the Forks of Salmon River at elevations between 5000 and 6000 feet. Chert occupies a great deal of the country between Tanner's Peak, the New River Divide and Orleans Basin, and manganese oxides are apt to be found in it anywhere. Numerous claims have been staked this spring (1918) on prospects in this territory, which is accessible only by rough pack trails from Sawyer's Bar, Forks of Salmon, and Orleans. If any of these should be developed to the productive stage, ore would have to be packed out, preferably to Orleans, from which a fair road would permit hauling by auto trucks during dry weather to Korb, 62 miles distant. Two prospects have been opened east of the mountains, one in Cottonwood District from which ore can be hauled to Ager, and the other in Deadwood District, 6 miles from Fort Jones. Early production is promised from both. Shasta County's production of manganese came from a siliceous ore body 1 mile from the Heroult smelter, where an attempt to make silico-manganese from the ore was abandoned as unprofitable.

Counties West of Sacramento Valley.

Three counties in this group, whose western portions are geologically linked with the Coast Ranges, but which are easiest reached from the east, contain manganese prospects in the Franciscan cherts. In Colusa County some work was done years ago on a prospect near Fouts Springs, but it was abandoned without production. Two

properties in Glenn County, 25 and 30 miles respectively, west of Fruto, have produced a few hundred tons, and one of them is still active. Near the south county line, just within Tehama County and 34 miles from the railroad at Corning, there are two undeveloped claims on which some work seems warranted, to judge by the grade of material exposed on the surface. These are near the east edge of the Franciscan area and just within the California National Forest. Going west toward the summit of the divide and north toward Tom Head Peak, there are reported to be other prospects of manganese. The country in these directions is rugged and little frequented except by stockmen.

Sierra Nevada Mountain Counties.

In this group of counties, manganese properties have been reported from Plumas, Butte, Nevada, Placer, Amador, Calaveras, Tuolumne and Tulare. The black oxides of manganese occur commonly in irregular shaped bodies enclosed in lenses of quartz, and as far as visited by the field men of this Bureau, appear to differ entirely from the Coast Range deposits.

Plumas County has been the largest producer of the group, one property having yielded over 1000 tons and another over 500 tons. Properties so far opened are near Crescent Mills, Indian Falls and Quiney. Only one of three properties near Clipper Mills in Butte County has produced.

Production from Nevada County so far has been a few carloads from two properties, one 7 miles from Colfax near the west bank of Bear River, and the other about 16 miles from Auburn in the Lime Kiln District. A recent discovery is reported to have been made on South Yuba River, one mile from Washington. Geological conditions are said to be similar to those described under Placer County, where mining is going on in a small way near the side of the road from Colfax to Yankee Jim. The prospects are $9\frac{1}{2}$ miles from Colfax. The mixed hard and soft black oxides of manganese are found in places as small, irregular bunches enclosed in quartz lenses which strike N. 5° W. and dip nearly vertically, in conformity with the enclosing rocks which have been altered to clay at the surface and are mapped as Calaveras formation (Carboniferous). Twenty tons of ore from one such prospect was said to carry 51.6% manganese. At a depth of 7 feet this ore was merging into rhodonite and carbonate. The indications so far point to the probability of numerous small, superficial ore bodies in this Carboniferous area, which extends to North Bloomfield. The long upgrade from the river to Colfax gives an expensive haul and the road is very heavy, though not absolutely impassable, in winter.

Production from Amador County has been from one property near Defender. Calaveras has made no production, and only one carload has been shipped from Tuolumne County, although new prospects are reported from the southwest end of the county, near the river, above Moccasin Creek.

Southern California.

The manganese deposits in the counties of Inyo, San Bernardino, Los Angeles, Riverside and Imperial are typically vein deposits, and of these the fissure deposits seem to be the more common, although there are several contact deposits described in the report. In the desert country, intrusive rocks commonly carry the mixed manganese oxides in narrow, well-defined veins. Psilomelane, with its characteristic botryoidal surface, is a prominent ore. The silicate rhodonite has been noted and will probably be found in greater quantity as development at depth is done. An interesting type of deposit is found in San Bernardino County where a foot of pyrolusite is reported on a contact of limestone and granite. Pyrolusite is also reported from the Owl Hole Mine in that county in contacts and as fissure filling in a system of parallel veins in granite. It is thought that the limestone originally covered most of the granite and that the ore deposition occurred at the same time in the contact and in the underlying fissures in granite, but that the limestone has since been largely removed by erosion.

Riverside and Imperial Counties have been the principal producers. The Black Jack Mine in Riverside County produced about 1500 tons in 1915 and 1916 and production was resumed in 1917, the ore lately shipped being clean, high-grade oxide carrying from 44% to 54% manganese and from 1% to 6% silica. Mineral Station is the principal shipping point for Riverside County, the haul being from 2 to 23 miles over desert roads. Glamis, Imperial County, is another important shipping point.

The Owl Hole Mine in San Bernardino County was a large producer in 1916. The ore-body is as much as 6 feet wide. Ore carrying 75% MnO_2 and less than 1% Fe_2O_3 was shipped for chemical use, while lower grade ore was shipped for steel making. Riggs, 35 miles distant on the Tonopah and Tidewater Railroad, is the shipping point. This property became active again in May, 1918, after being idle in litigation for a year.

POSSIBILITIES OF CONCENTRATING MANGANESE ORES.

After rather extensive tests carried on under his supervision at the University of California, Professor E. A. Hersam has recently reviewed the possibilities of applying the different methods of concentration

to California manganese ores¹³, and his conclusions are summarized below.

As a preliminary step to concentration by other means, dry crushing and screening was tried. It was found that the finer material was usually richer than the coarser, at any stage, in the case of pyrolusite or other soft oxide ore, but not in the case of the carbonate and some silicate ores. The separation was in no case sufficiently clean to be termed concentration.

Gravity concentration tests were not very satisfactory. The manganese minerals as a whole are not greatly superior in density to the gangue minerals; manganese minerals generally slime excessively in crushing, and are usually not well separated from the gangue. Because of these facts, wet concentration is apt to be imperfect, yielding a large proportion of a middlings product which is hard to handle. The only ores which appear susceptible to this mode of treatment are hard, pure ores which will break free from gangue.

Author's Note: Certain of the Southern California deposits, where high grade ore occurs in narrow but well-defined veins and stringers, divided sharply from the wall rocks, appear to be the most promising for tests of this kind. Concentration tests are now being made in the south on such ore from Riverside County.

Flotation and electro-static separation were not successful, but magnetic separation seems to have possibilities. Experiments by this method on a carbonate ore gave a concentrate carrying 38.6% manganese and a recovery of 96.7%. The same method applied after roasting the ore gave a recovery of 93.4% in a concentrate carrying 50.9% manganese. Here also, it was found that the hard, high-grade material was readily attracted and saved, but the softer particles such as pyrolusite, and the minerals which cannot be cleanly separated from gangue, gave less satisfactory results. Solution of the manganese minerals by sulphuric acid and deposition by electrolysis apparently would be applicable, as far as the extraction obtainable and quality of product are concerned.

ELECTRIC SMELTERS.

The **Noble Electric Steel Company** is operating two electric furnaces at their Heroult Smelter in Shasta County, making ferro-manganese. The electrodes used are 12" and 1500 k.w. are used on each electrode. Furnaces are lined with silica brick. Power is obtained from Northern California Power Company.

The ores used come mostly from California, and the contributing properties are scattered from one end of the state to the other. The company develops many properties and also buys ores from producers. They are the largest consumers of California manganese and the mar-

¹³Hersam, E. A., The possible treatment of manganese ores in California: Univ. Calif. Publ. Engin. Vol. 2, No. 1, 1918.

ket for their product is well established in the east. There is a great variation in ore, but a general average is 40% manganese, 16% silica, 1% to 3% iron, with sulphur and phosphorus entirely absent or present only in traces. Ore is delivered by rail to the smelter bins. From the ore and fluxes the constituents of the charge are drawn into a scale car. The make-up of an average charge is as follows for 80% ferro-manganese:

- 1 Ton 50% manganese ore (Average tenor of ore is lower).
- 800# Lime Rock.
- 60# Fluorspar (shipped from Colorado).
- 70# Iron Ore.
- 550# Charcoal or Coke (crushed fine).

From the scale car the charge is dumped down a gravity chute to the furnace, and mixes on the way, being also hand spread in the furnace. Metal is tapped every 3 hours, at a temperature of 1400° C. The button weighs about 1000 pounds. Each furnace produces 7 to 8 tons of ferro-manganese in 24 hours. The product varies from 70% to 80% manganese. Average content is said to be:

For 70% product		For 80% product
70%	Manganese	80%
20%	Iron	12%
6%	Carbon	6%
1% to 3%	Silicon	1% to 3%

Phosphorus and sulphur absent, or only as traces.

A recovery of 65% to 70% of the manganese in the ore is claimed. The slag carries 10% to 18% manganese. At present there appears to be no way of utilizing this economically. The lowest grade ore which they state they can use is 38% manganese and not over 19% silica. Some time ago they tried to make silico-manganese from ore mined near the smelter. This ore carried 20% manganese, 34% silica, 6.72% iron, and some sulphur, and the attempt to smelt it did not prove financially successful.

During the first quarter of 1918 the smelter treated about 3000 tons of California manganese ore. Some coke made in California from petroleum residue has been used whenever obtainable at a price warranting its purchase. The problem of electrode supply has been temporarily solved by a new supply from the east. As soon as possible it is planned to substitute 20" carbon electrodes for 12".

Intermittently, small amounts of ferro-silicon are made in a smaller furnace (600 k.w. capacity). The charge for making 75% ferro-silicon is:

1 Ton siliceous material (85% silica, 5%-10% iron).

1000# Charcoal.

400# Iron ore (local ore carries 68% Fe, 1-2% SiO₂).

This furnace is lined with silica. Metal is tapped at 1550° C. The market for this product is not regular enough to justify steady production.

Pacific Electro Metals Company, 593 Market St., San Francisco, have a new plant at Bay Point where they are making silico-manganese. Some ferro-manganese has been made. Additional furnaces will be added and ferro-chrome, ferro-nickel, ferro-tungsten and ferromolybdenum may be made later. At present one furnace is in operation and can turn out 12 tons silico-manganese daily. Another of equal capacity is partly built. The plant was designed by Beckman and Linden Engineering Corporation of San Francisco, and was financed by western capital. California materials are used, and it is gratifying to note that the state is capable of establishing and maintaining such an industry entirely without assistance from the east. With better transportation conditions and more cordial co-operation on the part of government agencies it is said that progress would be better.

The main furnace building is of reinforced concrete and 120 ft. x 50 ft. The furnace has a capacity of 3000 k.w. and is 3-phase with open top. The electrodes are 24 inches in diameter, are hexagonal in shape and 7 feet long. Trouble was caused at first by difficulty in getting electrodes. More recently, the company has erected a plant in which experimental work is going on in making electrodes from lamp black residue from local gas plants. Mr. Linden reports (Aug. 5, 1918) that the success of the process is assured, and says that some electrodes made in the plant are being used in the furnaces along with others of eastern manufacture.

The charge is shovelled around the electrodes and metal is tapped from the bottom, the process being continuous. In making silico-manganese, an ore carrying not less than 40% manganese and not over 20% silica is used, but one carrying 36% manganese and not over 18% silica could be used. The charge consists of ore, coke and iron turnings up to 3" in diameter. Some of the coke used has been made locally from residue of California oil refineries. The silico-manganese produced carries 50% to 55% manganese, 20% to 25% silica, less than 1% carbon, not over .18% phosphorus and trace of sulphur.

Sample lots of ferro-manganese made in test runs, carried 80% manganese, 3% carbon, 2% silica, balance iron.

With the completion of the other large furnace and 3 others of 300 k.w. capacity, the company will be in position to make the other ferro-alloys. This plant provides a market for such products as gas plant lamp black and crude oil residue coke, which have heretofore been of little or no value. By shipping to the east a silico-manganese of above analysis, there is also a saving in railroad rolling stock. A much greater actual weight of manganese is contained in a carload of the silico-manganese than in an average carload of crude ore; if we consider the average tenor of crude ore shipped from California mines to the east for metallurgical purposes to be 42% manganese, 8 carloads of 55% silico-manganese would represent 9 cars of crude ore. This saving of freight also ought to help the California miner to overcome the handicap imposed by the establishment of a government price on manganese ore, based on delivery at South Chicago. The enterprise certainly deserves co-operation from federal agencies, as well as from local people.

MINES.

ALAMEDA COUNTY.

Tesla District.

South and east from Tesla in Alameda County is an extensive area of Franciscan formations, consisting mainly of sandstones, and serpentine with lenses of chert. This Franciscan area is approximately two townships (12 miles) wide at its northern edge along the south side of Corral Hollow Creek, and at three townships south of there it is at least three townships (18 miles) wide. (See Map, Plate II.) It extends into San Joaquin, Santa Clara and Stanislaus counties. The main ridges of the Diablo Range in this district run nearly NE.-SW.

Exploration and development work have revealed three main mineralized belts in this area: 1. An eastern belt, largely of chert and containing deposits of manganese, some of them yielding ore of very good grade. This belt is entirely on the east side of the "Divide," that is, on the side of the drainage towards the San Joaquin River. 2. A western belt, largely of serpentine bodies but with chert and sandstone also present. In the serpentine are found the deposits of magnesite, and a few of chromite; while in the chert, deposits of manganese have been noted, and a few of them worked. This belt follows along the line of the Arroyo Mocho and the ridge on its westerly side, but continues on to the southeast beyond the headwaters of the Arroyo Mocho, following the Red Mountains divide for some distance. 3. Between these two above-noted belts, at least in the northern part of the area under consideration, there appears to be a third belt, showing deposits of manganese of lower grade than those of the other belts.

Manganese carbonate is found associated with the oxides, at several places in the Tesla district, particularly in the northern part of the eastern belt. The manganese ore bodies, whether veins or lenses, though occurring in somewhat regular belts as noted above, have no regularity of strike nor of dip. The strikes of the individual ore bodies vary through all intermediate angles from N.-S. to E.-W. They occur as interbedded lenses in jaspers of the Franciscan formation, varying in extent and thickness as well as character. In places the ore is deposited as the porous black dioxide, but often merely as stains along cracks in the jasper.

A few of the deposits were worked in the seventies and occasional mining has been done since. However, more of them are merely prospects and no large mines have been developed except the Ladd Mine in San Joaquin County and, more recently, the Buckeye Mine in Stanislaus County. The total production from 1894 to 1916, inclusive, was only 5264 tons, this total representing the output of several different deposits, some of which are now exhausted.

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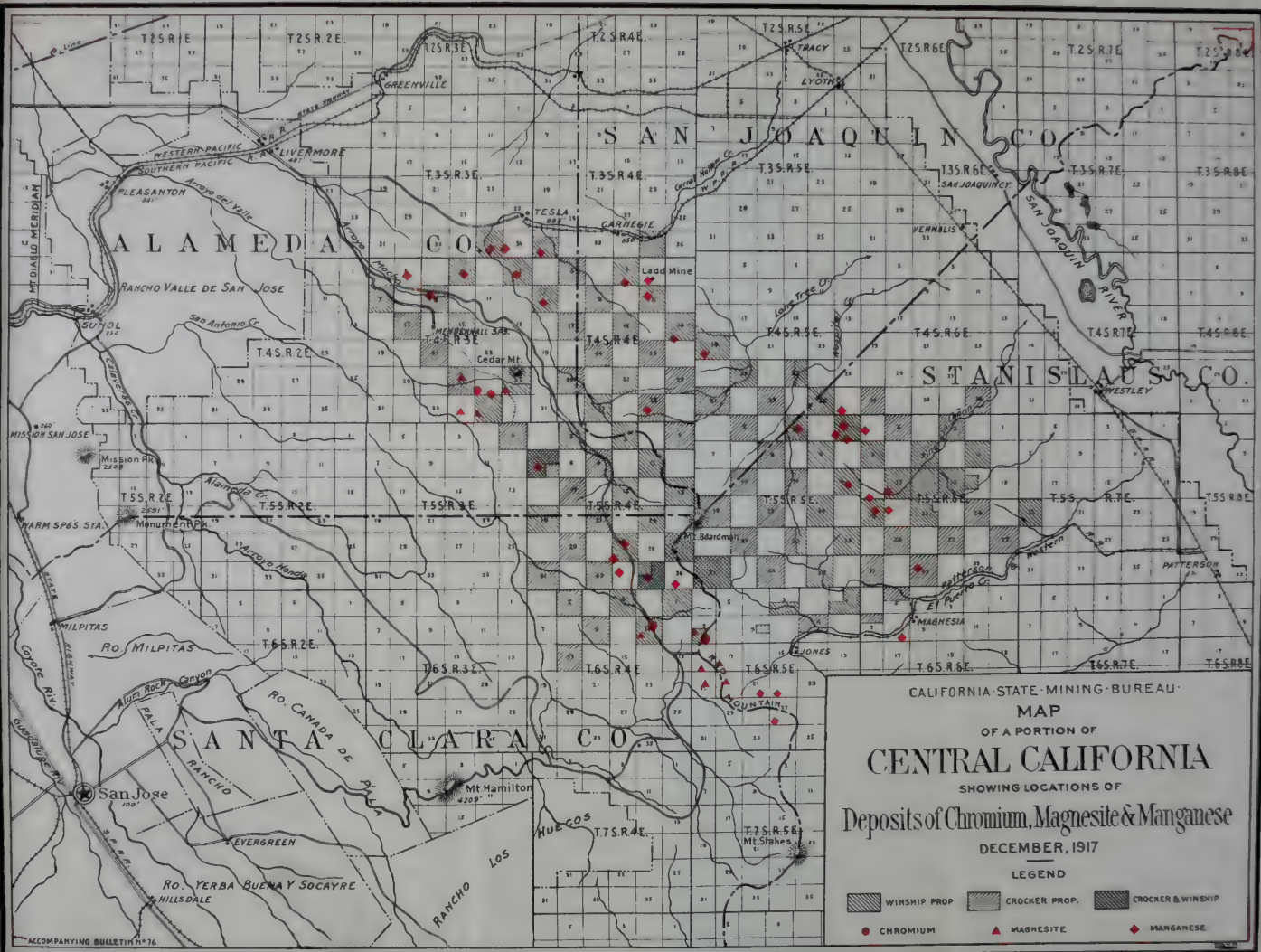
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ACCOMPANYING BULLETIN #76

CALIFORNIA STATE MINING BUREAU
 MAP
 OF A PORTION OF
CENTRAL CALIFORNIA
 SHOWING LOCATIONS OF
Deposits of Chromium, Magnesite & Manganese
 DECEMBER, 1917

LEGEND

WINSHIP PROP.
 CROCKER PROP.
 CROCKER & WINSHIP

● CHROMIUM
 ▲ MAGNESITE
 ◆ MANGANESE

Bailey Mine. See **Newhall Lease.**

John Beraudiere Mine is in the NE. $\frac{1}{4}$ of NW. $\frac{1}{4}$ of Sec. 14, T. 4 S., R. 3 E., 12 miles southeast of Livermore on the ridge northeast of the Arroyo Mocho at an elevation of 1750 feet. On the surface there is a large outcrop of jasper heavily stained with manganese. The largest of several open cuts made here exposed a bed of ore about four feet wide. Twenty-five feet vertically below the outcrop a tunnel was driven 60 feet and met a small open cut from the top, but developed no ore, as it was driven to one side of the deposit. The general strike of the bed is north and south with a dip of 50° to the east. John Beraudiere of Livermore is the owner. Forty-seven tons of ore had been produced here at the time of last visit.

Black Jack Mine is in the NE. $\frac{1}{4}$ of the same section as the above Beraudiere Mine adjoining it on the southeast. It was first opened in 1885 and some small shipments made. Very little development work has been done in recent years and no ore shipped since 1896. This deposit is described by E. C. Harder* as follows: "The country rock is jasper, thin layered and separated by seams of shale. The jasper layers differ in thickness from a fraction of an inch to several feet thick. The same layer varies in thickness, pinching out locally in many places. Most of the shale seams are thin. Both shale and jasper are greenish gray except where stained red or black by iron or manganese.

"The ore occurs in several interbedded lenses or pockets a few feet thick and of small extent. It is a soft, friable black oxide contained in cavities between numerous intersecting quartz seams, or as seams intersecting jasper fragments. Most of the quartz seams are later infiltrations. * * * The deposits commonly have a footwall that is thin-bedded and more shaly than the hanging wall."

Development consists of 35-foot tunnel and several small cuts. Forty tons of ore have been produced.

There are several small croppings on this property southeast of and below the Black Jack. A couple of shallow trenches expose a small deposit below the road. It was idle at the time visited. Horace T. Overacker of Livermore is the owner.

Bibl.: Bull. 38, p. 335; U. S. G. S. Bull. 427, pp. 161-162.

Buckhorn Claim. Chas. J. Janson of Livermore has a claim 16 miles southeast of Livermore on the Arroyo Mocho in Sec. 31, T. 4 S., R. 4 E. A few shallow cuts have been made on a prominently outcropping jasper ledge exposing some high grade ore. No ore has as yet been shipped and only assessment work done by owner.

Camp No. 9 (formerly known as the **Merchant Mine**). See **Crocker Properties.**

*U. S. G. S. Bull., 427, pp. 161-162.

Crocker Properties. M. I. Crocker, 1023 Insurance Exchange Building, San Francisco, owner. These include a number of patented sections in T. 4 and 5 S., R. 3 E., southeast of Livermore. Indications of manganese have been noted at several points, but at only one so far has commercial production resulted; that is at the old Merchant Mine in the NW. $\frac{1}{4}$ of Sec. 9, T. 4 S., R. 3 E., on the Arroyo Mocho road 9 miles from Livermore, also known locally as "Camp No. 9." It was opened first in 1888, and some ore shipped. This section is under lease to James J. Cummings, Livermore, who began operations in April, 1916, and he had shipped about 1000 tons of manganese ore up to September, 1917. The vein varies from 6" to 30" in width. The ore consists of both black oxide and rhodochrosite, the carbonate of manganese. The latter is called "gray ore" by the miners. The principal development work has been done through two adit drifts, one being about five feet above the level of the county road, all in oxide ore; and the second 30'-40' below, in carbonate and oxide ores. Stopes connect the two.

Crosby Prospects. Situated in SE. $\frac{1}{4}$ of SW. $\frac{1}{4}$ of Sec. 30, T. 4 S., R. 3 E., one-half mile by trail from the Crosby Ranch, which lies 12 miles from Livermore. Owned by the Wm. Crosby Estate. On the northerly prospect a large block containing about 50 tons of siliceous ore is exposed on the surface. On the other prospect, about 500 feet south of the first, there is a bed of massive chert three feet thick, containing a few pockets of manganese oxide. The northerly prospect promises to develop ore.

Cummings Lease. See Crocker Properties.

Dewhirst Mine. Mrs. Amanda Dewhirst, Livermore, owner. McDonald and Clark of Oakland, lessees. Lies 12 miles southeast of Livermore in NE. $\frac{1}{4}$ of SW. $\frac{1}{4}$ of Sec. 22, T. 4 S., R. 3 E., and is reached by the Cedar Mountain road. A lenticular body of massive manganese oxide ore striking east and dipping 50° south, in radiolarian chert, has been exposed in an open cut and a drift. From the drift ore was stoped nearly to the surface. Thirty tons of ore had been extracted and sacked when the property was visited.

Donavan Lease. See Winship Properties.

Ellis Ranch Deposit. A small vein of manganese ore has been exposed by an open cut on the ranch of Edward T. Ellis, eight miles southeast of Livermore on the Tesla road, in Sec. 28, T. 3 S., R. 3 E. Two small cuts, about ten feet apart, have been made on the vein which outcrops near the bottom of a gulch one-fourth of a mile south of the road. The ore is hard and blue black in color. Where exposed it was about 18" in width. About ten tons of good ore was lying on the two dumps. The property was idle.

R. Friggel Prospect is in the NW. $\frac{1}{4}$ of Sec. 22, T. 4 S., R. 3 E., near the Dewhirst Mine. Several blocks of siliceous manganese oxide lie in the soil on this claim. The relation to the country rock is not clear, but the manganese is thought to be landslide material. No commercial ore was seen here.

The Jumbo Prospect lies just east of the John Beraudiere Mine, in the NE. $\frac{1}{4}$ of the NE. $\frac{1}{4}$ of Sec. 14, T. 4 S., R. 3 E., and is held by the same owner, John Beraudiere. A small open cut and a short drift revealed siliceous manganese oxides lying within grey radiolarian chert. When visited in September, 1917, the manganese oxides exposed were too siliceous to be of value.

Several other exposures of low-grade manganese have been found nearby, south of the Jumbo. Some trenching has been done on these, but no important orebody has been uncovered.

Kelly Ranch Deposit, Mrs. Kelly, Livermore, owner. Holbrook and McGuire, San Francisco, lessees. This property lies at an elevation of 1450', in Sec. 5, T. 4 S., R. 3 E., one mile northeast of a point on the Arroyo Mocho Road, eight miles from Livermore. There are two bodies of massive oxide ore here. The northern ore body varies from five to seven feet in thickness and is separated from the southern ore body by six feet of barren jasper. The latter is at least three feet thick, but only one wall was exposed in September, 1917. Such ore as was in sight then was rather siliceous.

Merchant Mine. See Crocker Properties.

Man Ridge Mine. See **Scott and Winegar Mine.**

Newhall Manganese Lease, sometimes called the **Bailey Mine**, is situated in the SW. $\frac{1}{4}$ of NW. $\frac{1}{4}$ of Sec. 10, T. 4 S., R. 3 E., ten miles SE. of Livermore and one-fourth of a mile from the Arroyo Mocho Road, at an elevation of 2,200 feet. The principal workings are on the west side of a small tributary of Arroyo Mocho. Here a body of manganese oxide one to four feet wide in jasper was exposed. Work on the east side of the tributary revealed extremely siliceous manganese oxides. The property was sub-leased to C. F. Wentz in the summer of 1917. Up to September, 1917, 200 tons had been produced.

Newman Manganese Mine, formerly called the **Estacia** or **Fratis Mine**, is on Cedar Mountain, 12 miles southeast of Livermore in Sec. 22, T. 4 S., R. 3 E. This deposit has been worked in a small way at long intervals since 1880. Lenses of manganese oxides high in silica occur interbedded in jasper. The croppings have a strike of N. 30° W., and dip about 25° SE. Various shallow cuts reveal some friable black oxides of manganese in small cavities between numerous intersecting quartz seams. On the north center of the SW. $\frac{1}{4}$ of the section a small

open cut exposed two feet of siliceous ore, probably not of commercial grade. Leased to McDonald and Clark of Oakland in September, 1917.

Reay Deposit, W. R. Reay, #800 Bush street, San Francisco, owner, is in Sec. 36, T. 3 S., R. 3 E., M. D. M. On a line between Sec. 35 and Sec. 36 there are croppings of rather good looking manganese ore. About 300 yards or so east of the above-mentioned occurrence near the top of the ridge and well within the boundaries of Sec. 36, is a large outcrop of chert mixed with the black oxide of manganese. Undeveloped. An old wagon road, which could be put in repair for a nominal sum, passes nearby via Mitchell Ravine to Corral Hollow near Carnegie, a distance of two and one-half miles. Other occurrences of manganese have been reported from this section also.

J. W. Root, Box No. 2, Livermore, reports (May, 1918) that he has, ready to haul, four carloads of manganese ore which he mined from a recently located claim on Man Ridge. His property is on the southwest side of the ridge in either Sec. 7 or 18 of T. 5 S., R. 4 E.

Scott and Winegar Mine, sometimes known as the **Man Ridge Mine**, comprises two claims owned by Chas. Scott and P. S. Winegar of Livermore. Reached by two and one-half miles of rough road connecting with the Arroyo Mocho Road, at a point 20 miles southeast of Livermore. The mine is near the summit on the south slope of Man Ridge in unsurveyed land which would be in Sec. 7, T. 5 S., R. 4 E. On the south side of a small knob there are some caved workings from which the Noble Electric Steel Company produced about 600 tons of ore in the spring of 1917. The elevations of different workings vary and it is not clear if all the exposed ore is in the same or in different horizons; some faulting is seen, however. In one working two distinct horizons of ore occur, separated by a few feet of barren, thin-bedded chert.

On the north side of the same knob, Elliott and Searles of Oakland, have opened new workings, from which 350 tons of ore had been produced up to October 31, 1917. The orebody here is 10' to 12' thick, but its relation with the surrounding cherts is obscured.

Winegar Manganese Claim, owned by H. V. Winegar of Livermore is 20 miles southeast of that town, in the ridge east of Arroyo Mocho alongside the Camp Bessie Road. The country rocks are sandstone and shale, enclosing a few stray blocks of impure manganese oxides. Development work consists of a short tunnel, said to cut a lens of manganese oxide. Very little work has been done here in recent years.

Winship Properties, K. D. Winship, #350 Post Street, San Francisco, owner. In Alameda County, near Tesla, these properties include the following sections (See map, Plate II) which have manganese prospects or workings: Sec. 35, T. 3 S., R. 3 E.; Sec. 1 and 3, T. 4 S., R. 3 E., Sec. 31,

T. 3 S., R. 4 E., M. D. M., leased to Joseph P. Donovan, Livermore. Some indications of manganese have also been noted on Sec. 7, T. 4 S., R. 4 E., and on Sec. 7, T. 5 S., R. 4 E. Donovan reports (December 10, 1917) that on Sec. 31, above-noted, he has driven a 250-foot crosscut, and is now in a body of ore of good grade showing at least six feet in width.

AMADOR COUNTY.

The **Crocker-Preston** property is in the SW. $\frac{1}{4}$ of Sec. 35, T. 7 N., R. 12 E., M. D. M., $1\frac{1}{2}$ miles south of Volcano, and is owned by M. I. Crocker and J. W. Preston, Jr., 350 Post St., San Francisco. It is 12 miles from the railroad at Martell. There is a mineralized zone which strikes W. of N., stated to be traceable from Volcano for 2 miles southward, and was observed by the writer at two points at least $\frac{1}{2}$ mile apart. This zone appears to be at least 100' wide, and is on a contact between limestone on the hanging-wall (east) and a schist on the west. The dip is steep. The bulk of this material is siliceous, being a quartzite of the Calaveras series. There is also some quartz-mica schist.

Within this zone and striking more or less parallel with it are lenses of manganese ore, some of which resemble mineral springs' deposits filling fissures in disturbed areas of the enclosing formation. So far as exposed in the limited workings thus far opened up, these manganese lenses vary up to at least 6'-8' in width, possibly wider. The deepest working (August, 1918) is only down to about 25' below the surface. This is in a shaft and crosscut which connects with it. The crosscut is in about 40', and has a drift of about 20' along the strike. There are several shallow open cuts. From these workings located on the backbone of a sharp ridge, about 30 tons of good-looking ore had been sorted and piled up. A grab sample taken by the writer from each of these piles and combined, showed on analysis 46.04% Mn and 7.25% SiO₂.

On the eastern edge of this ridge about 100' northeasterly from the above-mentioned workings is an open cut which exposes a body of soft, black ore, interlaced with quartz veinlets. Some 60 sacks (6000 lb.) of this material had been gathered ready for shipment. A small sample of this material, taken by the writer from the face of the cut, showed on analysis 51.10% Mn and 12.97% SiO₂. Much of this silica could be eliminated by screening.

Altogether, this is rather a favorable prospect and worthy of further development. The quality of the ore is good, but the mode of occurrence is such that considerable care and judgment must be used in adopting such a system of mining as will yield a minimum of waste to be handled. In such a case, it is best to stick rather close to the ore lenses, at least until the nature and extent of them are better known.

L. Everett of Mokelumne Hill reports an undeveloped manganese prospect four miles east of Pine Grove.

Peyton et al., Lease. About a half-mile northerly from the Crocker-Preston property noted above, Lee Peyton et al., of Volcano, have a lease on another, similar prospect on the same belt, in the NW. $\frac{1}{4}$ of Sec. 35. There is a shaft down 30', and a short open cut at the mouth of the shaft. About 20 tons of ore had been (August, 1918) sorted out for shipment, and it looked to be high grade.

Rühser & Hubberty. A deposit of manganese one-half mile southeast of Defender is reported to have been worked by the Manganese Company of California in 1916. It is reported that 250 tons of ore were shipped and that about 50 tons remained on the dump because it could not be hauled over the roads during the winter of 1916-1917. The property is owned by F. W. Ruhser and Adam C. Hubberty of Jackson.

BUTTE COUNTY.

The Bear Canyon Mine is located one and one-half miles southeast of Clipper Mills in Sec. 35, T. 20 N., R. 7 E., M. D. M. In 1916 the Noble Electric Steel Corporation shipped 220 tons of 40% ore. The orebody varying from 4' to 20' wide was 50' long. Development work consisted of a cross-cut tunnel. The ledge carrying manganese oxide strikes east, and dips north in amphibolite near an area of serpentine.

The property has recently been leased to R. J. Bean of Clipper Mills, and R. C. Darby of Bangor, who are prospecting for more ore and sorting the old dump. Owned by Geo. W. Woolley of Clipper Mills.

The Powell Property consists of a 120-acre patent, located one mile north of Clipper Mills in Sec. 35, T. 20 N., R. 7 E., M. D. M. An 8'' siliceous manganese-bearing ledge striking N. 65° E. has been exposed to a depth of 30 feet by a shaft. Another ledge striking east and dipping 30° N. has been developed by a 50' open cut which exposes 30' of ledge matter. The property is now idle and owned by E. V. Powell of Clipper Mills.

The View Point Property consists of a 160-acre patent in Sections 34 and 35 of T. 20 N., R. 7 E., M. D. M. The View Point ledge outcrops for 40' and strikes N. 80° E. It is developed by an open cut 3' wide and 6' long on the east end, and is about 12'' wide. The westerly 20' of the outcrop is 20' wide, and is rather siliceous. The ore should become less siliceous with depth.

Approximately 1500 feet east of the View Point ledge and 300 feet from the road is a north-south ledge, very siliceous at outcrop, carrying some manganese. This ledge has been opened in one place by an open cut 6' deep and 20' long, which exposes 12'' of silica on the surface, below which is 12'' of sugary quartz with some crystallized manganese oxide and 4' of manganese with decomposed rock similar to that at the

View Point ledge. The south end of this same ledge is exposed within 150' of the road to the Bear Canyon mine. The exposure is very siliceous and strikes north south for 20', being 18' wide. The property is idle, but a small amount of development work has recently been done. Owned by E. C. Binet of Clipper Mills.

Wooley Mine. See **Bear Canyon Mine.**

CALAVERAS COUNTY.

The Fortner Ranch deposit occurs on the top of a ridge two miles northeast of San Andreas. Manganese oxide is associated with lenses of quartz in mica schist. The ore bodies are said to be traceable for over 150' along the ridge, outcropping as irregular lenses a foot or two in diameter which are subdivided into smaller pockets by a network of quartz veins. Little development work has been done. Owned by the Fortner Ranch, San Andreas.

The Manilla Manganese Property is in Sec. 27, T. 4 N., R. 11 E., M. D. M., on Bear Mountain, six miles southeast of Valley Springs. The extent of the deposit is not known, since no development work has been done. An assay of a sample of the material taken from near the surface shows 25% metallic manganese, 17.36% silica, and .055% phosphorus. Owned by Dave Manilla of Angles Camp.

CONTRA COSTA COUNTY.

Manganese occurs on Red Rock, in San Francisco Bay, just off the Contra Costa coast, and included within the county limits. This deposit is described by A. C. Lawson* as follows: "The ore occurs on the southwest side of the island as an integral part of the radiolarian chert. The chert here has a west-northwest strike and a nearly vertical dip, and consists of the usual rhythmical alternation of thin beds of hard, flinty to quartzose chert and partings of shale, the whole having a reddish color. A belt parallel to the strike of the chert includes interstratified layers of psilomelane, which, by reason of their black color, present a bold contrast to the adjoining rocks. Most of the layers are about one-fourth to one-half inch thick and replace locally the usual shale parting, but in places the psilomelane is much thicker. Some of the layers of the chert adjoining these layers of psilomelane are also so charged with that mineral as to be quite black, though they are still hard and siliceous. The psilomelane also occurs in minute particles in the shale between the chert beds, making it black. The borders of the belt in which these layers of psilomelane occur are not sharply defined, but the mineral has been mined in open cuts two to six feet wide. The ore appears to be essentially a primary deposit, contemporaneous with the deposition of the silica that formed the cherts,

*U. S. G. S., San Francisco Folio, No. 193, p. 23.

although doubtless some of the psilomelane has since migrated into adjoining beds.

"The shale partings north of the manganese ore outcrop on Red Rock are abnormally thick, generally measuring from half an inch to two inches, and at some places the shale is one to two feet thick. It has a soft, earthy consistence, and a shale structure and is prevailing red, though the color grades locally into yellow. This shale was at one time mined as mineral paint."

Some small bunches of manganese ore have been recently found on the southeast side of Mt. Diablo, but nothing of commercial consequence has as yet been developed.

FRESNO COUNTY.

The Avery manganese property is located nine miles from Coalinga on the road to Paso Robles. An assay of surface ore is said to have run 45% manganese and 20% silica. No development work has been done. The property is owned by George D. Avery of Porterville, Tulare County.

The Woods manganese property is on government land on Pine Flat near Piedra. The ore is said to carry 26% manganese and \$4.00 per ton in gold. The manganese is probably superficial. Owned by "Jake" Rice of Pine Flat.

GLENN COUNTY.

Black Diamond Mine. This property, embracing two claims, is in Sections 14 and 23, T. 18 N., R. 7. W., 30 miles by a good auto road southwest of Fruto, the shipping point. A body of manganese ore was struck in driving a tunnel on a copper prospect. It was at first thought to be very extensive as a width of 40 feet was exposed. Upon stopping, however, it pinched down to a narrow stringer, yielding only about 100 tons of good ore. The ore was shipped last summer by A. H. Noyes of San Francisco, who has a lease on the property. Although located 20 years ago, this was the first ore produced. Work ceased when the lens pinched down, but the lessees expect to resume development work by driving along the stringer in the near future. The orebody does not outcrop. Owners, A. W. Sehorn et al. of Willows, Cal.

Bibl.: Rept. XIV, p. 198.

Rattlesnake Manganese Mine. About two miles northwest in an air line from the Black Diamond Mine, and on the same range of low lying hills, is situated the Rattlesnake Mine. It is in the southeast quarter of Section 6, T. 18 N., R. 6 W., 25 miles by road from Fruto. The 5-ton auto truck in which ore is hauled to the railroad loads directly at the mine, which has been only recently opened. A deposit of high-grade manganese ore, comprising essentially the oxides, psilomelane and pyrolusite occurs in red jasper beds, near a serpentine contact. The strike of the beds is, in general, northwest and southeast, the dip

almost vertical. A shaft, now 20 feet deep, is being sunk and it exposes an ore body four to six feet in width. The ore does not outcrop but the jasper beds outcrop 300 feet to the southeast, showing manganese stains. About 50 tons of shipping ore, over 40% Mn, were sacked and being hauled to Fruto. It is intended to sink on the ore body to a depth of 30 feet and then drift. Four men are employed, producing from five to ten tons daily. Owners, A. H. Noyes, H. B. Chase, and T. Norris, Mechanics Institute Bldg., San Francisco.

HUMBOLDT COUNTY.

Porter Ranch Deposit. A deposit of high grade manganese ore occurs in the Franciscan jasper in the east central portion of the county, in the SW. $\frac{1}{4}$ of Sec. 32, T. 3 N., R. 4 E., approximately 30 miles by road east of Carlotta, a station on the Northwestern Pacific



Photo No. 1. Manganese deposit near Fort Baker, Humboldt County; L. M. Bryant, owner. Showing trench across deposit to expose length.

Railroad. The ore, which is largely pyrolusite, outcrops over a low knoll, covering several acres. It has been so eroded that there are no large croppings, and much of the ore lies broken over the surface. The jasper beds in which the ore occurs are very extensive and can be traced for four miles. Manganese oxides occur in several places along these beds, but the largest and most promising deposit is that in Section 5. At the time visited no work had been done on the deposit, but numerous samples were sent to the steel manufacturers in the East. In no cases did they fall below 40% metallic manganese, and in most cases ran over 50% metallic manganese, with 9% silica. This deposit suffers the disadvantage, however, of being rather inaccessible and in a rugged region. The elevation is 2150 feet (barometric) above sea level. The present

road from Carlotta, via Fort Baker, would be impossible to truck over, as there are several very heavy grades. By construction of a road $\frac{1}{2}$ mile long, the ore could be hauled out to Eureka over a road which is said to be in good condition and without heavy grades. Ample water for camp purposes is at hand in springs below the deposit. L. M. Bryant and brothers of Grizzly Bluff, are the lessees.*

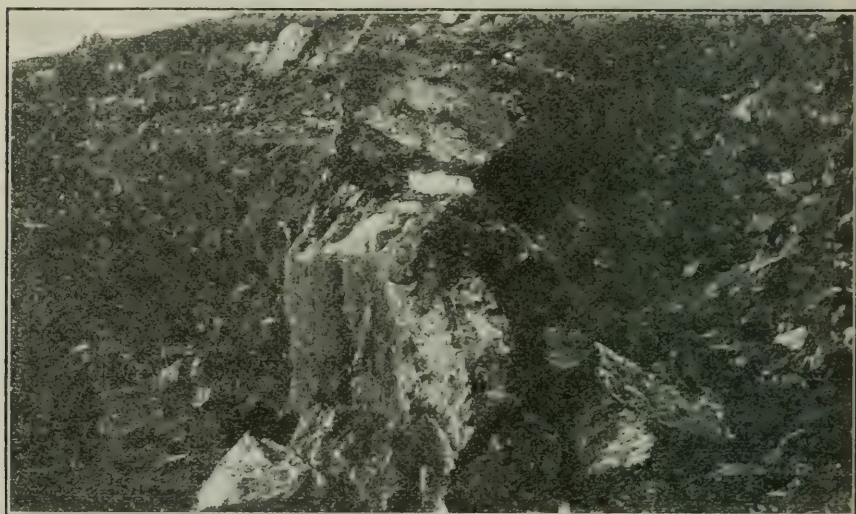


Photo No. 2. Manganese ore on property of L. M. Bryant, Humboldt County. Crosscut exposes high-grade ore.

Manganese deposits are reported to occur in the mountains east of **Blocksburg**, but judging from the samples submitted, the percentage of silica contained in the ore is too high to make them of present commercial importance.

Woods Prospect. Located 12 miles north-northwest of Blocksburg, in Sec. 3, T. 1 S., R. 4 E. Owned by Wilson Woods of Harris, Humboldt County, and under lease to F. M. Doak and Wm. C. Irvin.

IMPERIAL COUNTY.

The occurrence of deposits of manganese ore within its boundaries, and their acquisition as mining claims, are accomplished factors which point toward a possible production of manganese from Imperial County.

Ebony Group. This property, comprising 12 claims, is located in the eastern part of the county, 30 miles due southwest of Blythe, and 6 miles south of Wiley's Well on the road between Blythe and Glamis.

*Since this property was visited, the owners have made several trenches at various places across the deposit, and report it to be very extensive and of high grade. However, a depth of only a few feet has been attained. Samples sent to San Francisco for analysis ran 56.62% metallic manganese. The owners are now sinking on the orebody to determine its depth. There has been as yet no commercial production.

Blythe, though outside the county, is the nearest railroad point. Glamis is on the main line of the Southern Pacific. The typical Colorado Desert country is found here, broken by the Chocolate Mountains and cut by numerous arroyos along their base. The Arroyo Seco extends from the mountains to the Colorado River.

In an arroyo about $\frac{1}{4}$ mile south of the water tanks there is a vein of manganese ore (psilomelane) 2 ft. wide. It has a north and south strike with vertical dip. At an elevation of 1100' on the Chocolate Drop claim, there are two small open cuts developing 6" to 12" of ore. About 100' west of No. 1 open cut, there is a parallel vein striking north and south and dipping 70 degrees east.

On the slope of the ridge west of the arroyo, there is a series of shallow open cuts which expose streaks of manganese ore 6" to 18" wide, running north and south. West of the arroyo and about $\frac{1}{4}$ mile south of the first open cut croppings of stringers of manganese minerals can be traced for 100 ft. A number of shallow trenches have been sunk on these stringers.

On the Ebony No. 2 claim a vein of manganese ore varying from 8" to 2' in width, can be traced for 200'. This vein has been prospected by several shallow holes. In an arroyo on this claim there is a narrow vein of manganese ore 8" to 12" wide, cutting a rhyolite conglomerate.

The showing on Ebony No. 3 claim, which adjoins Ebony No. 1 on the west, is confined to a single vein of manganese ore. This vein, 6" to 8" wide, strikes north and south and can be traced on the surface for a distance of 100 ft.

On the Ebony No. 4 claim a bold outcrop of rhyolite conglomerate intimately mixed with stringers of manganese ore, strikes north and south. A series of shallow open cuts have been run on this. In a gulch running southeast and northwest $\frac{1}{4}$ mile from the tanks, there is found a scale of high grade ore on a wall of sandstone which dips to the southwest. The hanging wall is a brecciated rhyolite.

In general, the manganese occurs on this group in narrow veins of shallow depth, capable of producing but a small tonnage. This, and the distance to shipping point, reached only over a rough and sandy road, appear to be formidable obstacles to development.

The Ebony Group is owned by the East Rex Exploration Company, Robt. Kinsie, Secretary, First National Bank Building, San Francisco, Cal., but is under option to J. H. Lightfoot of Blythe.

Johnson Claims. A Mr. Johnson, of Glamis, owns two manganese claims located in the Chocolate Mountains about 30 miles northeast of the town. The property is approximately 5 miles west of the Colorado River and 10 miles east of the famous old Paymaster silver-lead mine. The deposit consists of narrow stringers and small kidneys of ore. No development work has been done.

* INYO COUNTY.

Deposits of manganese ores are attracting attention in this county, already noted for the great variety as well as for the value of its mineral resources.

Connard Bros. Claims. The Connard Bros. of New Jersey own 3 manganese claims on the northeast slope of the Panamint Mountains, opposite the south end of Death Valley, and 32 miles west of Zabriskie, a station on the Tonopah and Tidewater Railroad. They are near the old Borax road to Death Valley. The deposit consists of streaks of psilomelane 6" to 8" wide on both walls of a bed of calcite striking north and south in rhyolite. A spur vein 2 ft. in width which strikes N. 60 degrees E. and has a dip of 60 degrees, cuts into the main north and south vein at an elevation of 1000 ft. Only a small amount of development work has been done, but sufficient to show this deposit to be limited to narrow veins from which but little ore could be produced.

Death Valley Manganese Claims. These claims are crossed by the old Death Valley Borax road and are located in the immediate vicinity of the Connard Bros. claims. The deposit is of the same general character. On the southwest side of the road there are a number of stringer leads of manganese ore cutting an andesite breccia. The stringers run from a few inches up to 8 inches in width and form a series of parallel veins which strike N. 50° E. The elevation is 1400 ft. Of the nine full claims embraced in this property, six, called the Manganese No. 1, No. 2, No. 3, No. 4, No. 5 and No. 6 are on the northwest side of the road. Through these there extends a series of calcite veins cutting the rhyolite. The strike of the veins is north 50 degrees west, with a dip to the northeast. The ore occurs as streaks 6 to 8 inches wide along both walls of these veins. It is a high grade psilomelane ore but the quantity is small. The owners are E. P. Underwood, L. G. Henderson and associates, of Barstow.

LAKE COUNTY.

Manganese deposits occur in several localities of Lake County, but the deposits thus far found are in general small and erratic. Its occurrence is characteristic of most of the Coast Range deposits, the ore being the massive black oxides associated as stringers and lenses with the jasper beds of the Franciscan formation. The largest deposits found are those which occur on Mount Sanhedrin on the border of Mendocino County.*

These are at present too inaccessible to be of commercial importance. Of the several prospects visited, only one gave promise of developing into a mine.

*See under Mendocino County.

Coleman Prospect. Situated three miles west of Cobb P. O., in Sec. 29, T. 12 N., R. 9 W. Owned by J. H. Coleman of Cobb and J. D. Sullivan of Kelseyville. The claim is in a body of massive metamorphosed red chert which trends northwest along High Valley Creek for a distance of about 1400 feet. The chert is stained along fracture planes by manganese oxides and occasionally contains small bodies of good ore, although no body of workable size had been found when the property was visited. A smaller body of chert containing manganese was exposed $1\frac{1}{4}$ miles downstream.

Herman Prospect is owned by August Hermann and is located in Snell Valley, 11 miles from Middletown. This prospect was not visited, but specimens received from the property at different times indicate rather siliceous manganese oxide.

Herrick Prospect. S. B. Herrick, Middletown, owner. Lies three miles west of Middletown, in Sec. 25, T. 11 N., R. 8 W. There is a massive bed of siliceous manganese oxide 3 feet thick, in red radiolarian chert. The material exposed in a small open cut at the time of visit, was not of shipping grade.

Van Ranch Deposit. This property, owned by G. W. Van of Upper Lake, is situated in Sec. 3 and NW. $\frac{1}{4}$ of Sec. 10, T. 16 N., R. 10 W., on the southwestern slopes of Horse Mountain, at an elevation of about 2700 ft. above sea level, near the head of Middle Creek, which empties into Clear Lake. It is about $10\frac{1}{2}$ miles by road north of Upper Lake and 38 miles northeast of Ukiah, the nearest railroad point. The road which runs to the ranch house has been extended about 2 miles to the foot of Horse Mountain, $\frac{1}{4}$ mile from the mine. It is a road over which auto trucks could operate throughout the year by the construction of a couple of small bridges to span the creek at the crossings. Water for camp purposes is obtained from springs and Middle Creek.

The orebody occurs as a rather well defined ledge in jasper beds which strike northwest and dip 60 degrees northeast. These beds outcrop prominently over the mountain for several miles, showing manganese stainings at many places. The most favorable ore body seen was in NW. $\frac{1}{4}$ of Sec. 10, where all development work was being done at the time visited. This ledge, or lens, outcrops for 100 ft. along the strike, varying from 5' to 10' in width, and appears to be high in manganese. About 10 feet below each end of this cropping, short tunnels were being driven to cut the orebody, and midway between these tunnels, a crosscut driven 20' from a small open cut had exposed 6' of the porous black oxide. Four men were engaged in this development work. About 20 tons of ore were mined from a lens 1000 ft. northwest of the main outcrop, and 16 tons from another half way between the two. One carload of 40 tons had been hauled out to Ukiah, and it was expected to produce

from 5 to 10 tons daily. The property is being worked under lease by the Middle Creek Mining Company, a co-partnership between E. E. Holbrook, S. E. Burris and H. W. Sites, with offices at 45 Kearny Street, San Francisco.

LOS ANGELES COUNTY.

Manganese occurrences in this county have been prospected in two localities. The black oxides occur in mica schist, accompanied by such high percentages of silica as to render the material of doubtful commercial value.

Amargosa Group. Comprises nine claims in T. 6 N., R. 12 and 13 W., S. B. M., between four and five miles west of Palmdale. The group was located in January, 1914, by C. L. and A. H. Metzger, R. H. Gilman, R. Snowden and A. Mayet. Irregular kidneys of manganese oxides occur along siliceous outcrops in schist. The most extensive croppings are one mile north of the road on claim No. 5, where the manganese outcrops at intervals for 150 feet, striking east. Here an open pit six feet deep and 12 feet long exposes in the bottom two feet of manganese oxides apparently high in silica. Twenty tons of this material was shipped in 1917. Most work has been done on No. 1 claim, the easternmost of the group, and lying within 500 feet of the road. Here the Noble Electric Steel Company carried on work in 1916 under lease. They made a cut following the orebody for 30 feet, then sank a shaft 20 feet deep. A tunnel was also driven northwest along the body 20 feet below the cut. This exposed very siliceous manganese oxide. One carload was shipped by the above company, but lately only assessment work has been done.

Gladwin and Peet Claim lies in Sec. 36, T. 6 N., R. 14 W., at an elevation of 4900 feet (barometric) almost 2000 feet in elevation above the end of the wagon road in the cañon. It was first located years ago and relocated in September, 1917, by G. L. Gladwin and H. G. Peet of Los Angeles. The manganese oxides lie in small pockets along siliceous outcrops in the schist. The material is siliceous and in general low grade. Two small pockets, extending only a few feet deep, have been uncovered. There are several tons of this low grade oxide lying on the dump, but it is doubtful whether it will ever be hauled out. There are several other siliceous outcrops on the claim, but no other manganese croppings were seen. The deposits are too small and of too low grade to be of commercial importance.

MARIN COUNTY.

On the **Mailliard Ranch**, eight miles northwest of San Rafael and one-half mile south of Woodacre Lodge, stains and irregular patches of oxide of manganese occur in red jasper, which apparently has been

caught up as blocks in serpentine. The material is high in silica and no work has been done on it. This is on Lot 9, Block 33 of a tract owned by the Lugunitas Development Co., 202 Commercial Bldg., San Francisco.

About one mile west of **Sausalito Point** manganese oxides occur, associated with massive jasper. The oxide is mostly of low grade but one streak has a thickness of 15 inches of fine ore which could be traced only about six feet, as no attempt had been made to open it up.

Another deposit of manganese is exposed in a road cut near **Fort Baker**. It is described by A. C. Lawson,* as follows:

“The manganese ore is well exposed as a stratified deposit of hard, clean psilomelane about 18 inches thick, grading off in its upper part into a lean ore consisting of chert and shale highly charged with the black manganese mineral. There is no definite boundary between this lean ore and the normal radiolarian cherts, for the proportion of psilomelane simply decreased till it ceases to color the rock. The thickness of the ore-impregnated cherts above the layer of psilomelane is about 12 feet. This body of ore lies within a few feet of an intrusive contact of ellipsoidal basalt with the cherts, the contact plane being parallel to the bedding, and may be traced for 90 feet on the outcrop of the formation which dips about 40 degrees southwest. In several samples taken by D. C. Billick, the psilomelane contains gold not exceeding 40 cents to the ton.”

MENDOCINO COUNTY.

The Franciscan formation occupies about three-fourths the area of the county covering the entire eastern portion from north to south. The jasper beds associated with this formation are very extensive, and their outcrops can be traced for many miles, striking in general northwest and southeast with the trend of the Coast Range Mountains. Associated with these jasper beds many deposits of manganese ores have been found, and undoubtedly more will be uncovered.

The greater number of the deposits developed lie in that group of the Coast Range Mountains east of the Northwestern Pacific Railroad, and within easy access of it.

Several promising prospects have been located in that mountainous region between Mt. Sanhedrin on the border of Lake County, and Round Valley. Due, however, to its lack of transportation facilities, combined with the rugged character of this section, there is little possibility of any large production being made in the near future. Roads would have to be constructed and the numerous mountain streams bridged, thus considerable development work is necessary before determining whether such expense would be justified.

*U. S. G. S., San Francisco Folio No. 193, p. 23.

Big Bend Claims are situated in SW. $\frac{1}{4}$ of Sec. 28, T. 23 N., R. 11 W., on the Middle Fork of Eel River. The owners are C. V. Brerton, W. E. Shields and M. G. and J. D. Morrison. A fair grade of float ore is reported from here, but no development work had been done late in 1917.

At **Bland's Cove** D. D. McLaughlin has nine claims carrying outcrops of manganese which were undeveloped in October, 1917.

The **Busch & Bevins Manganese Mine**, also known as the **Lee Mine** or **Potter Valley Mine**, is in Sections 3 and 10, T. 17 N., R. 12 W., five

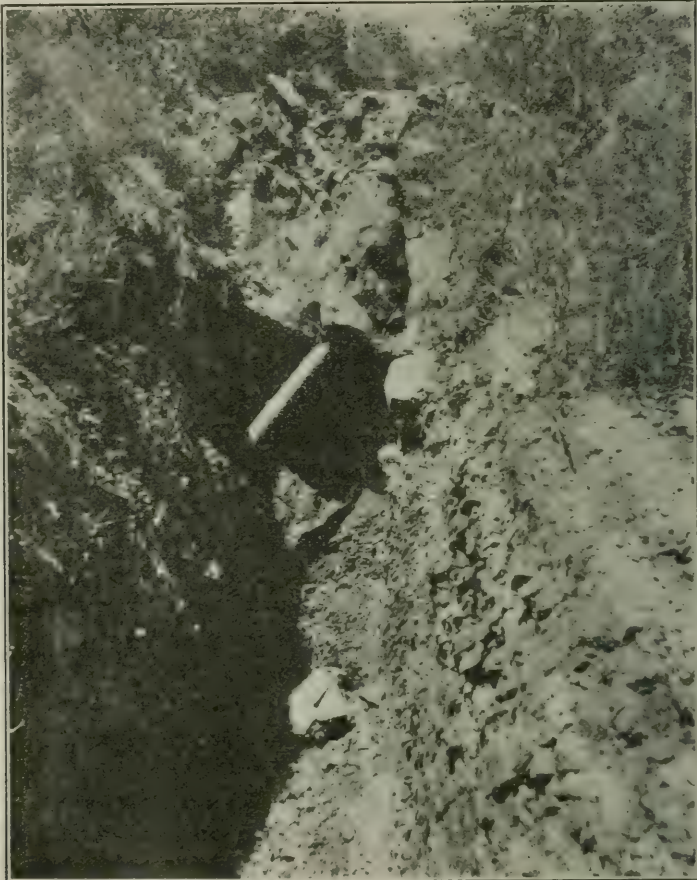


Photo No. 3. Busch & Bevins Manganese Mine, Mendocino County, showing lens of good ore 3'-4' wide, exposed in short tunnel.

miles northwest of Potter Valley Postoffice and 22 miles north of Ukiah, the shipping point. It lies on the same range as the Thomas and Wild Devil Mines, at an elevation of about 1500 feet above sea level. The road is in good condition for trucking, with the exception of the last mile. Here it follows the creek and is impassable during the rainy

season. To date six lenses of oxide ore, one to two feet wide, in red chert, have been found at this property which comprises 500 acres. These are located about 500 feet above the creek bed. The only one mined is now practically exhausted; it yielded 140 tons of ore which averaged over 45% manganese. The ore was hauled by a gravity tramway to a loading platform in the cañon alongside of the road. Very little development work has been done on the others, so it is impossible



Photo No. 4. Loading platform at foot of gravity tram, at Busch & Bevins Manganese Mine, Mendocino County.

to determine their extent; however, in the two short crosscuts, ore bodies were exposed which varied from one to two and one-half feet in width. The other pockets or lenses were exposed by small open cuts. The ore in these appears to run high in silica, as is the condition of all the croppings seen. There are undoubtedly large tonnages of low grade ores here, as these lenses outcrop at intervals for several miles over the ridge.

At the time visited, the property was idle, but a lease had just been taken upon it, by F. W. Keeny and associates, with offices at 307 Syнди-

cate Bldg., Oakland. The terms of its lease called for resumption of operations within 10 days. S. H. Busch, J. J. Busch, and A. P. Bevins of Potter Valley, are the owners.

Cleveland Property. It is situated in Sec. 13, T. 16 N., R. 12 W., three miles east of the railroad station at Calpella, on the Potter Valley Road. A small kidney of hard black oxide has been exposed by an open cut for a width of about two feet on a contact of jasper and black shale. Considerable float covers the steep side hill on which this deposit occurs, and the jasper beds are quite extensive, but no other ore bodies were seen. No ore has been produced here, but a fair body might be developed by further work. It has the advantage of being within easy access of the railroad. It is idle. Owner, R. L. Cleveland of Ukiah.

Bibl.: Rept. XIV, p. 421.

Foster Mountain Mine, also known as the **Independent Mine**, is in Section 3 or 4, T. 18 N., R. 12 W., 14 miles by road east of Willits. The



Photo No. 5. Screening manganese ore in open cut at Independent (Foster Mountain) Mine, Mendocino County.

mine, discovered over 20 years ago, and relocated in 1914, lies near the summit of Foster Mountain, almost 1000 feet in elevation, above the loading platform at terminus of the truck road. The camp is located alongside of Tomki Creek, which supplies ample water for camp purposes.

The ore body is developed by a glory hole 60 feet along its strike, showing a width of from three feet to ten feet of ore throughout. Forty feet in elevation above this cut, a shaft is being sunk. At 20 feet depth, the ore body was encountered, here measuring six feet in width. The ore exposed in the shaft is very



Photo No. 6. Thirty tons of high-grade manganese ore on dump at Independent Mine, Mendocino County.

high grade. Twenty feet southeast of the shaft there is a rich cropping one foot in width. It lies on the strike of the main ore body and is undoubtedly a continuation of it. To date 1100 tons of ore which averaged over 45% manganese and less than 7% silica, have been shipped from this one orebody, and there are at least estimate as many tons in sight. To the northwestward there are several promising croppings but they have not as yet been developed. The ore is hauled down to the motor trucks by a team and sled at a cost of \$1.50 per ton, then to the railroad at Willits at \$5.50 per ton on board the cars. Mining costs are figured at \$3.00 per ton. The present production varies from 6 to 10 tons daily, with eight men employed. The mine was

operated under a one-year lease, by James E. Page of Willits. Geo. Busch of Potter Valley, Cal., is the owner. Leased to Noble Electric Steel Co., and idle in October, 1917.

Hopper Claim is in the south center of Sec. 16, T. 17 N., R. 11 W., one mile east of Potter Valley. Manganese oxides occur in blocks of chert that have been included in an intrusive mass of Franciscan greenstone. The chert has been metamorphosed by the intrusive and has taken on brilliant orange and vermilion colors. It sometimes shows spherulitic structure. Manganese oxides occur as veinlets cutting the altered chert. Occasionally these veinlets expand, producing a small amount of siliceous ore. There is no apparent possibility of developing ore here.

Near the summit of **Leech Lake Mountain** in a very inaccessible section, an undeveloped manganese prospect is reported.

Little Deer Claim lies in Sec. 17, T. 25 N., R. 12 W., 27 miles north of Covelo, and is owned by G. E. Purell and A. G. Trinkle. There are some manganiferous outcrops here which were undeveloped at the time of last report.

There is a small deposit of manganese on the **Walter McClendon Ranch** about five miles northeast of Calpella, and adjoining the W. P. Thomas property on the south. It is reported that a carload of manganese ore was shipped from here during the past year. No work has been done since.

Michaels, Roman and Weeks, of San Francisco, have a lease on a manganese deposit in Sections 23 and 30, T. 23 N., R. 11 W., 20 miles east of the railroad at Dos Rios station. Manganese oxides occur in jasper beds, which outcrop prominently along a steep hillside east of the Middle Fork of Eel River. About 30 tons were mined by open cut and tunnel, and part of it was hauled to Dos Rios. The remainder is lying alongside of the roadway below the deposit. The outcrop extends for several hundred feet, but its ore is in general low grade and only the richer portions have been gouged out. In hauling to the railroad, the ore has to be transported across the river either by an aerial tramway or ferry, as there is no bridge. An attachment was filed against the operators last fall, so that no ore has been shipped and the property has been idle since. Chas. Brereton of Covelo is the owner.

Mt. Sanhedrin Claims. This property comprises two groups: the **Rhodochrosite Claims** and the **Black Leases**.

The **Rhodochrosite Claims** are located at Impassable Rock, in the SE. $\frac{1}{4}$ of NE. $\frac{1}{4}$ of Sec. 6, T. 19 N., R. 11 W. Impassable Rock presents steep cliffs to the southwest, below which there is a talus slope of angular fragments of radiolarian chert. The exposed cherts contain considerable manganese oxides, disseminated in fissure fillings and as stains.

Three definite oxide ore-bodies appear in the cliff face of Impassable Rock, and the talus slope carries blocks of manganese ore. The latter are most abundant near the base of the slope. The amount of ore in sight, however, is small.

Not far from the base of the talus slope an open cut shows a lens of carbonate ore averaging 4' thick. The lens is exposed for 30' along its strike, but its total extent is not determinable. In a creek below the open cut numerous masses of carbonate ore from 100 pounds to one ton in weight are also found.

To reach a shipping point a road might be built from Impassable Rock to Rackout Springs, a distance of 3 miles. Thence it is 6 miles by the Henshaw road to Hearst, and 16 miles from Hearst to Willits.

Black Leases. This group is composed of 9 claims, located 8 miles from Hearst. They are reached by a trail $2\frac{1}{2}$ miles long from Rackout Springs on the Henshaw Ranch road. The entire group is leased by P. C. Black of Oakland, and with the exception of the Lone Indian location (owned by W. Clark of Covelo) all the claims are owned by W. D. Frey, Jim Jameson and Wm. E. Shields.

The leasehold lies in Sec. 30, T. 20 N., R. 11 W., on the spur of a ridge which runs down to Elk Creek from Mt. Sanhedrin. In Sec. 30 this spur is divided into two ridges by a deep canyon running north, tributary to Gulf Creek. Part of the claims are on the east ridge and part on the west ridge. The Lone Indian claim is on the south end of the east ridge near its junction with the west ridge. About 500' north of this is the Original Big Jim claim, and 500' northeast of the workings on the Original Big Jim, is Big Jim No. 1. Continuing down the east ridge toward the north, one encounters several manganese showings, but no important ore-bodies have yet been uncovered.

Other claims are located on the western ridge. Big Jim No. 6 is near the south end, and Big Jim No. 7 about 500' north. Farther north on this ridge are several showings of manganese, but no important body has been exposed.

In general, the workings on the Black Leases are shallow. The ore-bodies are all of the same character, consisting of massive beds of rather siliceous ore enclosed in radiolarian chert. The ore is chiefly manganese oxide, containing considerable silica. Rhodochrosite is encountered in some of the workings, however, and it is probable that other carbonate ore-bodies will be encountered in depth.

Development work has been confined mostly to the Original Big Jim claim, on which there are two open cuts, one with a face 15' high and 20' in width, and another smaller cut 50' above. It is not clear whether these are on the same ore body, faulted, or on two separate horizons. There are small open cuts on the other claims.

No production has been made, but a few tons of shipping ore have been sacked.

New Year Manganese Claims. C. V. Brereton, Covelo, owner. Leased to L. E. Rusner and C. W. Hymer of San Francisco. The claims are 7 miles northwest of Covelo in SW. $\frac{1}{4}$ of Sec. 31, T. 23 N., R. 11 W. The property has been developed by open cuts, in two of which oxide ore of good quality has been found. The ore is one to two feet wide, associated with red and green jasper. Fifty tons of ore had been shipped in 1917. Analysis by A. A. Hanks showed 54.16% manganese and 5.75% silica in the best ore.

W. D. Rhodes and G. H. Hurt own an undeveloped manganese prospect in Sec. 36, T. 23 N., R. 12 W., $5\frac{1}{2}$ miles west-northwest of Covelo.

Shell Rock Manganese Deposits. The Noble Electric Steel Company is developing a manganese prospect 6 miles by road west of Spyrock station on the Northwestern Pacific railroad. The manganese ores occur in lenses interbedded in jasper whose outcrop forms a bluff about 500 ft. in length and 50 ft. high. The deposit has only recently been opened so that very little development work had been done. Two men are employed.

Alex Guthrie of Spyrock has located a claim one mile from the Noble Electric Company's property, but no development work has been done on it.

Thatcher Creek Claims. A number of claims have been located in Thatcher Creek Cañon in the northeastern portion of the county, about 18 miles by road and trail east of Dos Rios station. This region is very inaccessible, as there is no road within eight miles. W. E. Shields and C. C. Packwood of Covelo located a group of 6 claims in 1916 on a mineral deposit here which was said to contain both chrome and manganese. The ore body lies within schist walls, striking northwest and southeast and dipping vertically. It outcrops prominently over a ridge for 1300 ft., varying in width from 35 ft. at the creek to 75 ft. near top of ridge, exposing many thousand tons of this material. Analysis of samples taken by C. F. Nourse of San Francisco showed only a little over 7% manganese and no chrome.

Thomas Manganese Mine. This property, embracing eight claims, is situated in Sections 22, 27, 34 and 35, T. 17 N., R. 12 W., 6 miles by good auto road northeast of Redwood station, on the same ridge and about 3 miles in an air line southeast of the Busch and Bevins mine. The claims were located in 1912, and the first commercial production took place in 1914, the property at that time being worked under a lease by the Noble Electric Steel Company. To date over 3000 tons of high grade ore have been produced. The manganese ore occurs as a ledge

along heavy jasper beds, which constitute a large portion of the ridge. In places the ore is bluish black and amorphous, and intermixed with the jasper with no clear line of demarcation between, while again it is deposited in rich pockets with well defined walls. The ore body outcrops at intervals for three-quarters of a mile, striking N. 12° W. and dipping N. 65° to 80° E.; varying in width from 3 to 15 feet. It has been stripped for over 500 ft. down the ridge by a series of open cuts. Most of the development work has been confined to the north



Photo No. 7. Tunnel at W. P. Thomas Manganese Mine, near Ukiah; Mendocino County. Orebody at this point above 4' wide.

end of the claims, and several tunnels have been driven to crosscut the ore body below the open cuts. As in the case of most of the properties visited, the richer portions of the ore body have been worked out, and very little high grade ore is now exposed. With systematic development, other rich bodies will probably be uncovered. The property is easily accessible and could be worked the greater part of the year. The ore is hauled to the railroad at \$3.00 per ton. Water for camp purposes is obtained from a group of springs. As the deposit is located about 500 ft. below the roadway, it was necessary to haul the ore up the ridge. This was accomplished by a car oper-

ated by a hoist, using a gas engine for power. A couple of men were doing some development work in an old tunnel when visited and had about 10 tons of high grade ore ready for shipment. W. P. Thomas et al. of Ukiah are the owners.

Bibl.: Rept. XIV, page 421.

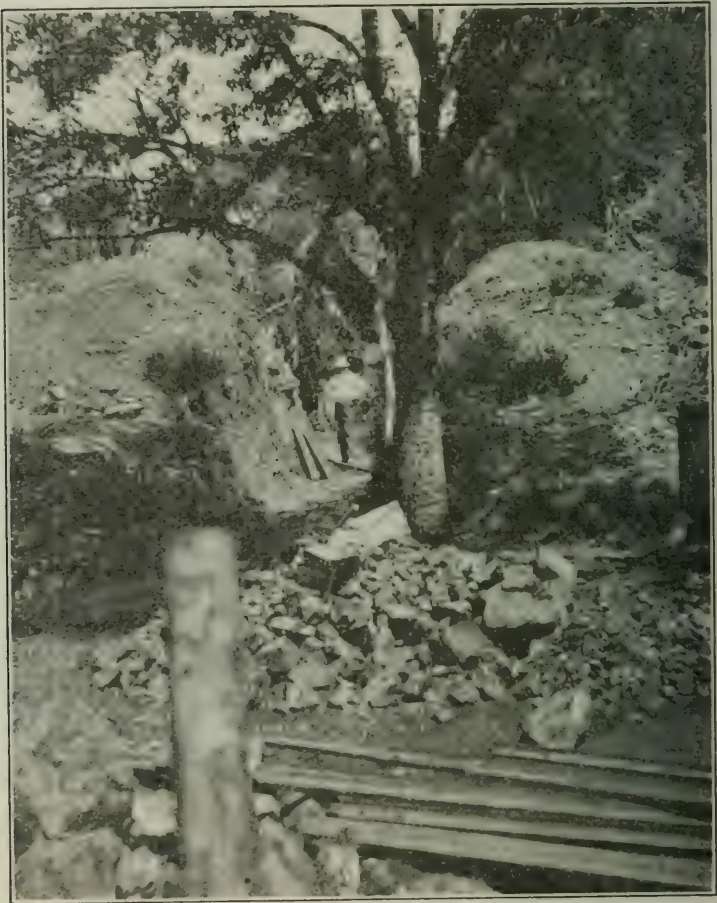


Photo No. 8. Wild Devil Manganese Mine, Mendocino County, showing trench opened along vein.

The Wild Devil Manganese Mine, also known as the **Waldteufel Mine**, is in Secs. 10, 15 and 16, T. 17 N., R. 12 W., eight miles from Redwood Station, about two miles by road north of the Thomas Mine and on the same ridge at an elevation of about 2000 feet. This property, embracing 18 mineral claims along top of ridge, was located in 1914, and worked under lease by the Noble Electric Steel Company during 1916. They developed one deposit, in the SW. $\frac{1}{4}$ of NW. $\frac{1}{4}$ of Sec. 15,

from which about 100 tons of ore was shipped. This was mined in a trench, or cut, 150 feet long. The orebody varied from 1' to 3' in width, in red radiolarian chert which strikes N. 30° W. and dips 10° to 45° E. There are several small pockets of high grade ore exposed in the bottom of the cut, which might develop into another body with depth. Fifty feet below the cut, a small lens is exposed by a shallow open cut across a face 5 feet long and 1' to 2' wide. The ore here appears to carry both lime and silica. No other work has been done on the claims, and there are no other ore bodies exposed. The property is idle. J. C. Waldteufel of Ukiah, is agent for the owner, Geo. E. Cameron of Pittsburg, Pennsylvania.

MERCED COUNTY.

Briggs Mine. This property is in the S. $\frac{1}{2}$ of NW. $\frac{1}{4}$ of Sec. 13, T. 13 S., R. 9 E., in the extreme southwestern corner of the county and 26 miles by road east of Tres Pinos, San Benito County. It is



Photo No. 9. Outcrop at Briggs Manganese Deposit, San Benito County.

owned by Mrs. Anna E. Briggs, of Hollister, and in November, 1917, was under lease to John Burmeister. Mr. Grayson of Hollister was beginning development work at that time.

Franciscan chert, enclosed in sandstone, outcrops in steep cliffs near the top of the ridge at an elevation of 3550 feet (aneroid) on the northeast side of the Diablo Range. The chert is from 75' to 100' thick

and dips northeast at angles up to 20° . Massive chert, enclosed in thin-bedded radiolarian chert, carries manganese oxide bodies. Minor faults have disturbed the bedding and have obscured the relation of the manganese oxide to the chert, but at least two horizons, and maybe more, exist. The hard blue-black oxide grades imperceptibly into the red jasper. For a distance of 150 feet along the strike (northwestward) indications are very favorable for developing a good deposit.

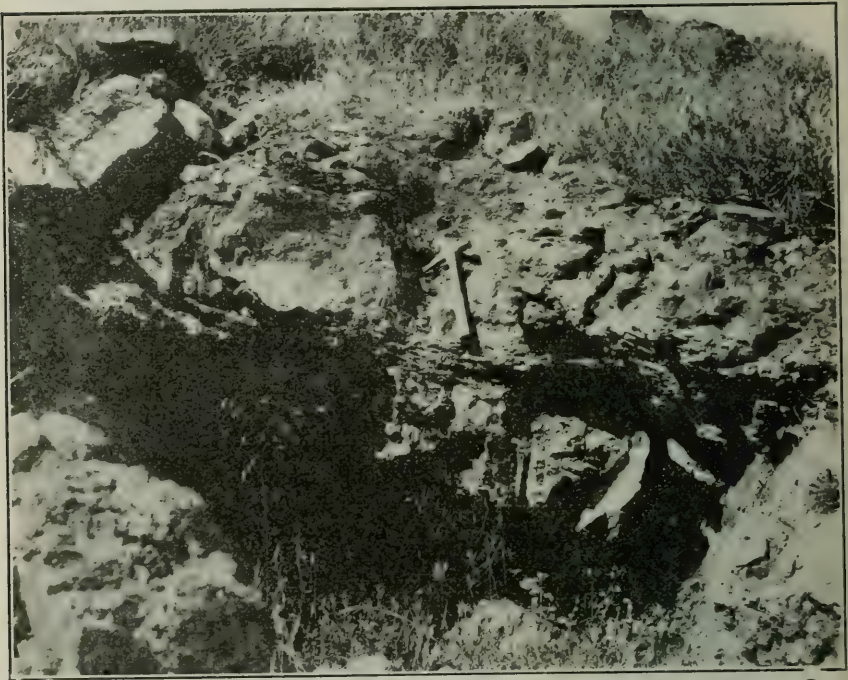


Photo No. 10. Open cut at Briggs Manganese Mine, showing face of high-grade ore 3'-4' wide.

There is a trail one-half mile long from the road to the deposit. The slope to the west is too steep for a road and a tramway would have to be constructed to get ore down to the road, unless it was found better to take ore out via Los Banos.

MONTEREY COUNTY.

The Santa Lucia Range extends northwest across the southern end of the county, and forms steep, inaccessible cliffs along the Pacific. The district is remote from traveled roads and sparsely inhabited. Only one manganese deposit has been noted in the county.

The Ross Ranch Prospect is one mile from the ocean and three miles north of the mouth of San Carpojaro Creek, in the extreme southwest corner of the county. The deposit is similar to those in San Luis Obispo County in the same range farther southeast. It is entirely undeveloped,

but a recent assay of a random sample gave 40% manganese, and the deposit is said to be promising. If it were developed it might be possible to load the ore on steamers from shore near the property. J. Dutra Ross, Cambria, owner.

NAPA COUNTY.

Bacon & Kenney Prospect is five miles west of Oakville by road, in Sec. 19, T. 7 N., R. 5 W. F. W. Kenney and Thos. Bacon of Oakland, did some development work here, but the deposit was too small and of too low grade to warrant exploitation, so that it is idle.

Bibl. : Rept. XIV, p. 276.

Cavagnaro Prospect lies in Sec. 3, T. 9 N., R. 6 W., one-half mile west of the *Ætna* Quicksilver Mine, at an elevation of 2200 feet, and is the property of Chas. Cavagnaro of Middletown, Lake County. The small amount of work which had been done in August, 1917, showed a body of manganese oxide 4' to 6' wide, with a length of 100'. It contained considerable iron and silica. No ore had been produced at that time.

Moore Creek Manganese Deposit, sometimes called the **Manganese Ridge Prospect**, lies on the ridge of the same name, which runs east and west and is a spur of the main ridge separating Conn Valley and Moore Creek. The property is in Sec. 15, T. 8 N., R. 5 W., six miles northeast of St. Helena. An old wagon road runs within 100 yards of the deposit, which is at an elevation of 1200 feet.

Some of the samples from this property were high grade manganese oxide. On the south slope of the ridge an open cut has been made; 100 yards northwest there is another small cut and to the south of the latter a tunnel.

NEVADA COUNTY.

Bartholf and Veach Mine. Seven miles from Colfax near the west bank of Bear River, E. H. and W. E. Bartholf and J. L. Veach of Colfax mined a carload of ore three years ago and have mined and sold two carloads recently (July, 1918). Mode of occurrence is similar to that in Placer County.

The **Wren Ranch** property consists of 160 acres in Sec. 20, T. 14 N., R. 8 E., M. D. M., of the Lime Kiln district at an elevation of 1000 feet. It is owned by R. M. Wren of Wolf, Nevada County, and leased by C. E. Loofbourrow of Oakland.

A body of manganese 14' thick and 10' long has been exposed to a depth of 20' by an incline shaft. Ten tons of ore mined, up to November, 1917, is reported to assay 50% to 60% metallic manganese and 6% silica.

PLACER COUNTY.

Gray Lease. Lee Gray of Colfax has recently leased from the Southern Pacific Company 80 acres of land in Sec. 29, T. 14 N., R. 10 E., adjoining the Tilsley and Coplen Group on the south. He reports promising prospects just south of the American claim. The property has not been developed yet (August 6, 1918).

Tilsley and Coplen Group comprises four unpatented claims known as American, Republic, Spokane and Crown Point, which were located in January, 1918, by A. D. Coplen and B. F. Tilsley, but have since been leased to C. S. Simpson of Monrovia, agent for eastern interests. He was opening ore bodies on two of the claims in June. The claims are 9 miles from Colfax and are crossed by the road leading to Yankee Jim. The south end-line of American claim is on the south line of Sec. 20, T. 14 N., R. 10 E., and the other claims lie parallel to and east of American claim. The claims lie at elevations of from 1900' to 2525'.

Near the south end-line of American claim in Mexican Gulch, a hole had been sunk 7 feet and a drift driven 25 feet along strike of country rock in ore. Twenty tons or more of ore said to average 51.6% manganese, 5.6% insoluble and .09% phosphorous, had been taken out up to June 13. The country rock is superficially clay, mapped as Calaveras formation. The ore is enclosed in a quartz lens about 100 feet long, which strikes N. 5° W., and dips nearly vertically. As revealed by work done at time of visit, the ore body has a rough elbow shape, plunges south and pitches 75° E. At the north, the short drift passes below tip of ore, but on south ore is going down, showing an increasing proportion of rhodonite. Ore body was nowhere over 4' wide, and was about 35' long. North of the road on the center of the same claim, a small shallow cut on a quartzose outcrop led to a face of ore 3' wide, capped by and enclosed in quartz. A few tons of ore, possibly of shipping grade, had been mined.

The Crown Point prospect has been opened near the top of a ridge north of the road at an elevation of 2525 feet. An open cut and a cross-cut tunnel running 50 feet northeast cuts in the order named: (1) 6" to 12" soft powdery oxide, ribbed by quartz stringers; (2) 5' siliceous manganese ore; (3) 5' clay; (4) 4' lean oxide of manganese, intercalated with clay. This zone is crossed by many quartz stringers. The zone strikes N. 5° W. and dips nearly vertically. An assay of ore mined here indicated 39.17% manganese, 20.64% insoluble, .07% phosphorus.

The prospects on the other claims were lean outcrops which had not been developed at time of visit. The indications point to the probability of there being numerous small shallow ore bodies in this

belt of Calaveras rocks, which extends as far as North Bloomfield. Ore from the above claims will be hauled to Colfax over a road which is good in summer. There are 2.8 miles of easy down-grade to American River, the remaining 6.2 miles being a steady up-grade. Two cars of ore are said to be ready for shipment August 6, 1918.

PLUMAS COUNTY.

The Braito manganese property includes one claim in Sec. 26, T. 26 N., R. 9 E., M. D. M., near Crescent Mills. The exposures of ore are on the slope of a hill which has a good growth of pine timber.

The ore body lies in schist and strikes northwest. It is developed by two open cuts and a tunnel. The tunnel is 57' long and shows a small amount of ore in the face. One open cut is 15' long with a face of mixed ore 4' wide and 12' high. Another cut 12' long shows a mixed ore from 6' to 7' wide. About 70 tons of ore piled for shipment was said to assay 50% metallic manganese and 12% silica. From 30 to 40 men were employed by the Noble Electric Steel Corporation, who were going to ship the ore to their Heroult smelter for use in making ferro-manganese. Up to January 1, 1918, 20 carloads of ore were shipped from this property.

Owned by Fred E. Braito and T. J. Mason of Crescent Mills.

Burch and Woody Prospect is near the line of Secs. 21 and 28, T. 26 N., R. 9 E., four miles west of Crescent Mills. When the property was visited a small amount of manganese oxide, which was too siliceous to sell, had been taken out.

The Crystal Lake Manganese Group consists of three claims in Sec. 8, T. 25 N., R. 10 E., on Mount Hough five miles east of Indian Falls and nine miles northwest of Quincy Junction. Most of the ore is on two claims and can be traced for 200' along the strike, which is N. 42° W. The orebody as exposed by two crosscuts showed 6' of ore which pitches 80° southwest. About one-half mile of road would have to be built to reach the deposits. Two springs furnish sufficient water for camp purposes.

Since this locality was visited the property has been developed by Geo. K. Allen and a Mr. Robinson of San Francisco, who shipped ten cars of ore to the Heroult smelter, and then sold their lease to Smith Bros. of Taylorsville. The claims are owned by H. A. and R. L. Klop-penburg and H. S. Myton of Quincy.

The Diadem Lode is one of a group of three claims which include 20 acres, in the Edmanton district. The property lies 14 miles south of west from Quincy in Sec. 33, T. 24 N., R. 8 E., and is owned by the Edman Estate, Quincy.

Manganese oxide and rhodonite (manganese silicate) are reported to occur in a quartz vein associated with iron oxide. The vein strikes

N. 37° W. and dips 60° N.E. No development work for manganese has been carried on, and it is believed that the deposit is only superficial. Equipment consists of buildings, shop and two Huntington mills.

Iron Queen Claim was located by Chas. Devlinn and A. F. Smith, in Sec. 8, T. 26 N., R. 9 E., about six miles northwest of Crescent Mills. Two small short open cuts had developed a little good ore, but most of the manganese oxide was too siliceous.

The Penrose Mine is located on Mumford Hill, three miles southwest of Meadow Valley, near Edmanton. Manganese occurs as oxides in the gossan of a quartz vein, similar to that at the Diadem Lode. The deposit is probably superficial. Owned by the Edman Estate of Quincy.

RIVERSIDE COUNTY.

Ore deposits of this important mineral are found at several points in Riverside County. Shipments of a good grade of ore have been made spasmodically for the past three years from the Schellenger property (Black Jack Mine) in the McCoy Mountains. At this writing, February, 1918, there is considerable activity in this district, and several properties are now shipping ore via Mineral, a station on the California-Southern Railroad. A number of recent locations have been made here, and there are probably 30 men working. The persistency of the ore bodies thus far developed augurs favorably for a large output from this region. Ten Ford trucks of one and one-half ton capacity are being used to haul the ore to the railroad. The only disadvantage the locality suffers is its lack of water; this has to be hauled in to camp from the railroad.

Black Jack Mine. This property, commonly known as the **Schellenger Claims**, lies near the base of the east slope of the McCoy Mountains, near their north end. The group of five claims lies at an altitude of 1200 feet, and is described as being in Sections 13 and 24, T. 4 S., R. 19 E., 12 miles by road northwest of Mineral Station. The extreme northeastern workings are on Claim No. 1. This consists of two tunnels: one 25 feet long, at an elevation of 1350 feet, driven on a vein which strikes S. 10° E., and dips 65° W., developing two and one-half feet of psilomelane ore; and one 30 feet higher up which has a length of 60 feet, and is stoped out to the surface in places along the vein. The face of this tunnel shows a high grade streak of ore 18" wide, which disappears here, the manganese ore becoming intermixed with brecciated rhyolite. The footwall of the vein is brecciated rhyolite and the hanging wall rhyolite. The ore croppings on this vein can be traced for a distance of 300 feet on the northwest slope of the hill at an elevation of 1000 feet.

About 600 feet west of these workings on Claim No. 2, at an elevation of about 1350 feet, two short tunnels and an open cut 20 feet in length

have developed four to five feet of manganese ore intermixed with brecciated rhyolite.

The main workings are on Claim No. 3, which lies south of Claim No. 2. Practically all of the mining is now being done here. The workings consist of an open cut 50 feet long, 25 feet deep and 5 feet wide. Below this cut a tunnel, now about 90 feet from portal, is being driven on a vein of high grade ore which varies from two to six feet in width. The ore occurs along a fault fracture striking S. 10° E., with a dip of 65° N.W. A winze is being sunk on the vein about 50 feet from the portal. It is now 25 feet deep, and the vein appears to be becoming wider and of higher grade with depth. Undoubtedly, a

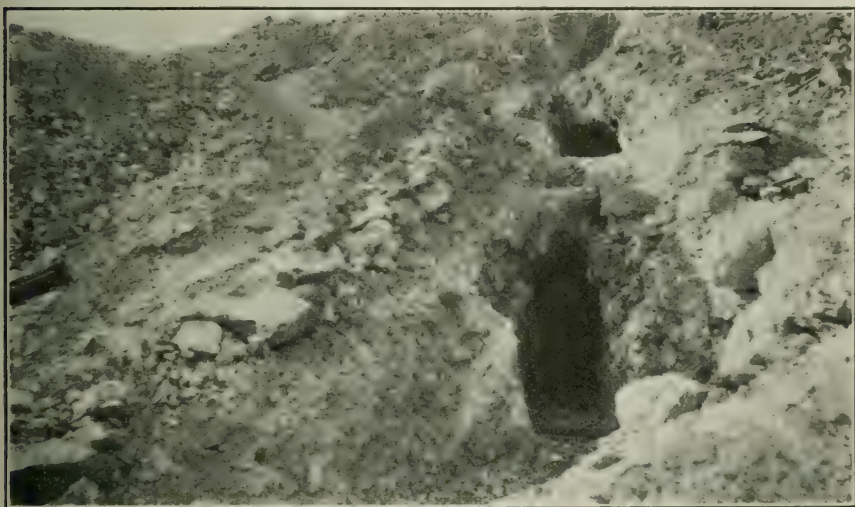


Photo No. 11. Tunnel and open cut on Schellenger Manganese Claims, in the McCoy Mountains, Riverside County.

large tonnage will shortly be developed in this working. The ore can be easily traced for a distance of a couple of hundred feet to the southeast along this fracture. The dump at this working, which contains several thousand tons, is said to average better than 30% Mn.

The manganese ore throughout these claims occurs in a series of parallel fractures along the northeast slope of the hill, which extends through a porphyritic rhyolite, highly brecciated along the fractures. The veins are evidently very persistent as their croppings can be traced at intervals for several thousand feet. During 1915, the property was worked under lease by Robert Kinzie and associates of San Francisco, who shipped out 1500 tons of ore said to average over 40% Mn.

In 1917, a bond and lease was taken on it by Chas. F. Bradford and associates of Blythe, the present operators. During the past few months, six car loads of ore have been shipped out. The assays on these ship-

ments varied from 44% to 54% Mn, and from 1.30% to 5.58% SiO₂. About 1000 tons of ore have been shipped out, which it is reported will average 47% Mn. At present less than a dozen men are employed, but new men are being put to work as fast as they can be obtained, and it is expected to be producing a carload a day within the next few months. Work is to be started on Claims No. 1 and No. 2 immediately. Floyd Brown of Blythe, has the contract for hauling the ore. Chas. F. Bradford is managing the property.

Black Horse Group. **Floyd Brown, P. H. Bray** and **W. Simoyne**, of Blythe, have located a group of four claims west of the Black Jack Mine described above. The surface croppings show narrow veins in the rhyolite striking parallel to those of the Black Jack Group. These locations have only recently been made, and no work has as yet been started.

P. H. Bray, of Blythe, is mining a deposit which lies about 1000 ft. south of Claim No. 3 of the Black Jack Group. The vein here appears to be a continuation of the Black Jack No. 3, as it lies along the strike of that vein, and is proving to be very strong with depth. The ore is psilomelane exhibiting the concentric structure and botryoidal surface which is characteristic of the ore of this district. A 25-ft. shaft was sunk on the vein, which at the outcrop consisted of manganese ore intermixed with brecciated rhyolite over a width of a couple of feet. The vein has gradually been widening with depth, and becoming richer in manganese. At the bottom of the shaft there is very little of the brecciated material, and the vein is about five feet wide. Drifts are being driven along the vein north and south from this level, and show ore four to five feet wide in both faces. A carload of good ore had been shipped and 30 tons more said to run 44% manganese were on the stock pile in February, 1918. Three men are employed.

Brum and Newport Prospect. A deposit of manganese has recently been located seven miles by road southwest of Perris on the Temecula branch of the Santa Fe Railroad. The deposit occurs on a low ridge 1000 feet west of the railroad. The ore, manganese oxides, occurs as lenses interbedded in jasper. The jasper is thin-bedded and extensive, outcropping for several miles in a northwesterly course. The beds are stained in many places with the manganese but development work has been confined to two rather promising outcrops. The lower working, probably 300 feet above the railroad, consists of a 30 ft. tunnel driven to cut an orebody which outcrops 40 feet above. This ledge or lens dips 45° into the hill, and in the face of the tunnel shows a width of three feet. The ore appears to be quite siliceous, but along the footwall side shows about one foot of the hard black oxide. Throughout the remainder, it is intermixed with the jasper, and varies from the soft

powdery dioxide to the hard massive ore. The outcrop of this body can be traced only a few feet, but the ore appears to be of fairly high grade. There are about twenty tons on the dump here from which several tons of high grade ore could undoubtedly be recovered by hand sorting.

The upper working is a couple of hundred feet above and about 500 feet west of the lower. Here a 50 ft. shaft was sunk on the orebody, which varies in width from three to four feet. The ledge consists of stringers of high grade ore 3" to 8" wide separated by the cherty seams. Twenty feet below the collar of the shaft, a tunnel was driven to cut the vein. On the summit of the ridge, about 30 feet above the shaft, there is a small cropping showing some good ore. There are 20 to 30 tons of ore taken from the shaft on the dump, which appears to be quite siliceous.

It is reported that there are some promising outcrops east of the railroad in a canyon tributary to Railroad Canyon about one and a half miles distant, but no development work has been done upon them. George Brum, Lloyd Newport, et al., of Perris, are the owners of this property which is covered by a group of several claims. An option has recently been taken on the group by Harford and Greenleaf, of Perris, Cal. An analysis of a sample from this deposit was made by Smith Emery and Co. It showed 34.42% manganese, 9.52% silica, and 0.140% phosphorus.

Doran Manganese Claims. The Doran property is located in the north end of the Palen Mountains, about ten miles northwest of the Black Jack Mine, and 22 miles northwest of Mineral. Packards Well lies about six miles to the north. The locations comprise two claims extending end to end in a general northerly and southerly direction. These claims embrace the top of the ridge, whose elevation here, at the point of discovery, is 2500 ft. above sea level, and about 700 ft. above the wash at its base. The road from Mineral to Adams Well lies probably three miles in an air line west of the property. From this point it is accessible only by a hard desert trail.

The manganese occurrence here is very similar to that of the McCoy Mountains, the ore being deposited in a vein, which is a filling in a fault fracture in rhyolite. The outcrop is first observed about 300 feet below the summit, striking a little east of south. Here it has a width of several feet, but is intermixed with the brecciated rhyolite. A small cut shows about 18" of high grade ore. The vein can be followed over the summit and down the south slope for several hundred feet. At the few places where cuts have been made, it appears to be widening with depth. About 50 feet east of the main vein, a series of croppings were observed which evidently mark a parallel vein. Ore from these claims assayed 44% metallic manganese, and 3.9% silica.

The locations were made in 1915, but due to their inaccessibility have never been developed. Considerable work must be done before it can be determined whether the veins will yield a sufficient tonnage to warrant the expense of constructing a road to the property. W. C. Doran et al. of Los Angeles are the owners.

Elsinore Manganese Deposits. These deposits long known and located, lie 6 miles northeast of Elsinore, a station on the branch of the A. T. & S. F. R. R., extending south from San Bernardino, and are in Secs. 23 and 24, T. 5 S., R. 4 W. One group of six locations is west of the railroad and another group of nine locations is east of the railroad, and perhaps $\frac{1}{2}$ mile farther north. A portion of the property reaches the railroad while the farthest point of any location is less than $1\frac{1}{2}$ miles distant.

On Sec. 23, what was pointed out as the principal vein was visited, though another parallel vein is said to exist. This vein outcrops at the top of a hill some 1500 to 2000 ft. distant from and approximately 400 to 500 ft. above the railroad. The outcrop here is 3 ft. wide and a hole 3 ft. deep has been sunk upon it. Some 75 to 100 ft. distant, toward the railroad, a 10 ft. shaft has been sunk, showing the vein to be 4 ft. wide at the surface. Below this point is a tunnel 20 ft. in length, driven in the footwall, so the width of the vein is indeterminable. The central vein outcrops show an indefinite width, being considerably broken, and covered with detritus. This vein may be 16 to 20 ft. in width as the distance from the apparent foot to the hanging wall would indicate. The width can only be determined by trenching. The manganese occurs in this vein as rhodonite, decomposing to oxide at the surface. The country rock is granite and schist. Chas. P. Carter, of Elsinore, owner.

Grosse Manganese Claims. C. E. Grosse, of Blythe, has a group of 5 claims about $\frac{1}{4}$ mile south of the Black Jack group. The workings here consist of several shallow cuts, and two shafts. The veins show up very strongly, but there is more lime in the ore in the form of calcite crystals, than seen at the other properties. At the surface the veins are narrow, but in both of the shafts they are widening with depth. The two shafts are about 300 feet apart, and on opposite sides of a small ravine in which is situated the camp. It is expected to sink each shaft 50 feet and then start drifting on the vein. Two carloads have already been shipped, and there are about 30 tons on the stock pile. Work was started here in January, 1918.

Hauser, Martin and Cheeseborough Claims. Hauser, 1138 Oxford Avenue, Los Angeles. These claims, seven in number, are situated $2\frac{1}{2}$ miles from Mineral station on the California-Southern railroad in the eastern end of the county, just south of the Mabery and Brown deposit described below. Three cars of ore were shipped from this

property by the Noble Electric Steel Co., of San Francisco, a couple of years ago, and very little ore is now exposed. No work has been done here since.

Mabery and Brown Manganese Deposit. This property consisting of 12 claims, lies at the base of the east slope of the Maria Mountains, about two miles by road west of Mineral. The manganese ore here occurs as irregular pockets or lenses in a hard, almost marbleized, grayish white limestone. Numerous outcrops occur over the claims, the general trend of them being north and south. The croppings are generally large and of irregular shape; the manganese ores being usually intermixed with the limestone of which it is a replacement. Development consists of a shallow shaft 8 feet deep which was sunk on a very promising cropping. From this shaft, a large chamber has been opened, already yielding 2 car loads which averaged 44.2% Mn, and 2% SiO₂. The width of the ore body here is about 8 feet. To the south of this working, probably 300 feet, an open cut is being made on a cropping which shows a couple of feet of high grade ore. Work was only started in January, 1918, and production now averages 4 tons daily with 6 men employed. The numerous croppings on this property would lead one to believe that large tonnages of ore will be developed. H. N. Mabery, 1125 Elza Avenue, Los Angeles, and Chas. E. Brown, of Mecca, California, are the owners.

Palo Verde Region Manganese Claims. Messrs. Lugo and Justice Smith of Palo Verde, Imperial County, own some manganese claims, located 8 miles northwest of Palo Verde and 10 miles west of the Colorado River. The property is close to the line between Riverside and Imperial Counties. There are reported to be 500 tons of ore, carrying 35% metallic manganese, ready for shipment.

Palen Mountains Deposit. Frank Coffey of Mecca owns a number of claims for manganese in the Palen Mountains northeast of Blythe.

Schellenger Manganese Claims. See Black Jack Manganese Mine.

SAN BENITO COUNTY.

Fries Ranch. Several deposits of manganese ore associated with red jasper outcrop along a ridge in Sections 5 and 8, T. 13 S., R. 8 E., 18 miles by road east of Tres Pinos. As no development work has been done at the property, it is impossible to justify an opinion concerning their extent. The jasper beds outcrop as bold ledges near the summit of the ridge, striking northwest. It is in a continuation of these beds that the Hendricks Mine and Lewis Ranch deposit are located. The beds are more or less stained with manganese, and probably some fair deposits might be developed. It is idle. Peter Fries of Hollister, is the owner.

Hannagan Ranch Deposit. A deposit of manganese ore occurs in the SE. $\frac{1}{4}$ of SW. $\frac{1}{4}$ of Sec. 22, T. 15 S., R. 9 E., about 31 miles by road southeast of Tres Pinos, at the base of a low hill at the west end of Big Panoche Valley. The New Idria road runs within 1000 ft. of the deposit. It does not outcrop but has been exposed by an open cut about 6 ft. across, showing 3 ft. of good ore. The jasper beds in the vicinity are heavily stained with manganese. The deposit is under option to E. T. Stewart of Dos Palos, and was idle when visited.

Hawkins Ranch. The Noble Electric Steel Company developed a deposit of manganese ore on this property, which is in Section 35, T. 11 S., R. 6 E., 13 miles by road northeast of Hollister. The ore was mixed with the jasper, and carried considerable iron so that it had to be hand sorted before shipping. Three carloads were shipped in 1916, which averaged over 40% metallic manganese, and the property has not been developed since. T. S. Hawkins of Hollister is the owner. In the fall of 1917, this property was leased to John Burmeister and G. W. Grayson of Hollister was preparing to do development work for the lessee.

Hendricks Mine. This property comprising 80 acres of patented land, is in Section 24, T. 13 S., R. 8 E., 23 miles east of Tres Pinos, over a good auto road which runs within one-half mile of the mine. It



Photo No. 12. Open cut at Hendricks Mine, exposing ledge 10' high, 3'-6' wide, for a distance of 75'.

lies close to the Merced County line, and less than two miles in an air line from the Briggs Mine. The elevation at the tunnel is 1930 ft. It is reached by a trail from the road, which could be extended up to the workings with little cost. The jasper beds with which is associated a deposit of manganese oxides, outcrop prominently for several hundred feet, striking almost due east. An open cut or trench has been made along the croppings for 75 feet. In this trench is uncovered an orebody which varies from 6' to 10' in width. About 50' below this working, a tunnel has been driven for 135 ft. It cuts the deposit at about 80 ft. from the portal, probably a continuation of that exposed in the working above. The ore is psilomelane. It is in the red jasper, and in places is intermixed with it. The deposit is said to have been first worked over 30 years ago, but there is no record of any commercial production. It is one of the most favorable prospects visited and, judging from the ore body now exposed, should develop into a good mine. The only reason that can be attributed for its idleness at the present time, is the high price at which the property was held for many years. This discouraged operators and the owners did not care to develop it themselves. The owners are T. H. Hackett, Mrs. Anna Briggs, and L. E. Thornton. Dan McPhail of Hollister, is agent. Late in 1917 this property was leased to John Burmeister. His local agent, G. W. Grayson, planned early development.

Bibl.: Bull. 38, p. 336.

Lewis Ranch. A small deposit of manganese ore associated with jasper, outcrops near the top of a mountain in Section 7, T. 13 S., R. 8 E. This deposit adjoins that of the Fries Ranch in Section 8, and is of the same character. The road from Hollister and Tres Pinos extends to the ranch house below the deposit. No work has been done on it and the property is idle. William Lewis, Tres Pinos, Cal., is the owner.

SAN BERNARDINO COUNTY.

Despite the handicaps imposed by desert conditions, the production of manganese ore has made a fair start toward commercial success in San Bernardino County. While the output to date has come largely from a single property, undoubtedly in a highly mineralized area of this size (20,157 sq. mi.) other manganese deposits, now undeveloped, will in due time contribute.

Black Prince Group. The holdings consist of four claims situated on the north slope of the Avawatz Mountains, about 35 miles west of Riggs Station, on the Tonopah and Tidewater Railroad. Massive iron stained croppings of brecciated andesite strike east, and are cut by a series of small veins of manganese. There is no possibility of developing any tonnage on the property, and what has been developed

by a 5-foot shaft shows a high silica content. It is owned by C. S. Van Horn and C. E. Berkhart, of Daggett, California.

Emma Manganese Claims. Two manganese claims known as the Emma No. 1 and Emma No. 2 are owned by Ruben Stenton of Silver Lake. These claims are located on a ridge one mile north of the Owls Head Manganese Mine in the Owl Mountains, at an elevation of 2800 ft. They are about 36 miles slightly north and west of Riggs, or 45 miles northwest of Silver Lake, both stations on the Tonopah and Tidewater Railroad, north of Ludlow. The Owl Mountains are a small group southwest of Death Valley Narrows. A short crosscut tunnel has been driven 20 ft. cutting a contact between limestone and granite, and developing 12 inches of ore on the contact. This ore is a high grade pyrolusite and the outcrop along the contact can be traced for several hundred feet on the surface.

Lavic Mountain Deposit. Seven claims are embraced in this property, which is located five miles by road northwest of Ludlow. The claims are, however, within two miles of the Tonopah & Tidewater tracks. The Lavic Mountains, in which they are situated, are a typical low mountain range of the desert country. A series of parallel veins of manganese ore outcrop in this range, striking N. 60° W. and cutting a rhyolite breccia. The outcrops are strong and may be followed for a distance of a mile in length. On the northwest end of the claims there is an open cut three feet deep on a fracture striking N. 60° W., exposing two and one-half feet of ore. Elevation 2900 ft. Fifty feet southeast of this open cut is a second one showing three feet of pyrolusite ore. On the southeast end of the claims, there are two open cuts on the same veins as the above which show five feet of ore, the manganese, however, being intermixed with a brecciated material which makes it run high in silica. Three hundred feet east of this vein there is another vein striking N. 60° W., upon which a number of prospect holes show from 12 inches to one and one-half feet of ore. About fifty tons of ore have been extracted from these open cuts but it evidently runs high in silica. The owners of this property are Alf Seymour, T. D. Garringer and L. V. Root, all of Daggett.

Owls Hole Manganese Mine. This mine first opened up in 1914, has a substantial production record, and under the name of either the Owls Head or Owls Hole Manganese Mine is probably the best known deposit of manganese ore in the southern counties. The property is in the Owl Mountains southwest of Death Valley Narrows at the southern end of the valley, in the same locality as the Emma manganese claims previously described. It is a little northwest of the Owls Hole Spring, a source of water supply and 35 miles north of west from Riggs, the shipping point on the Tonopah and Tidewater Railroad. The property includes 21 claims, which lie at an average elevation of 2400 ft.

The ore occurs along a series of fault fractures which strike northwest and southeast in a granite formation, and also as lenses along the contact between the granite and overlying limestone or granite conglomerate. This limestone at one time probably covered the whole area of the granite formation, but has since been eroded. Along the fractures which are more or less parallel, two shafts have been sunk to a depth of 60 feet. The ore developed in these workings shows a width of four to six feet, and is a good grade pyrolusite. There is also an open cut 50 feet in length on a parallel vein 50 feet west of the north shaft which shows three feet of good ore on its south face.

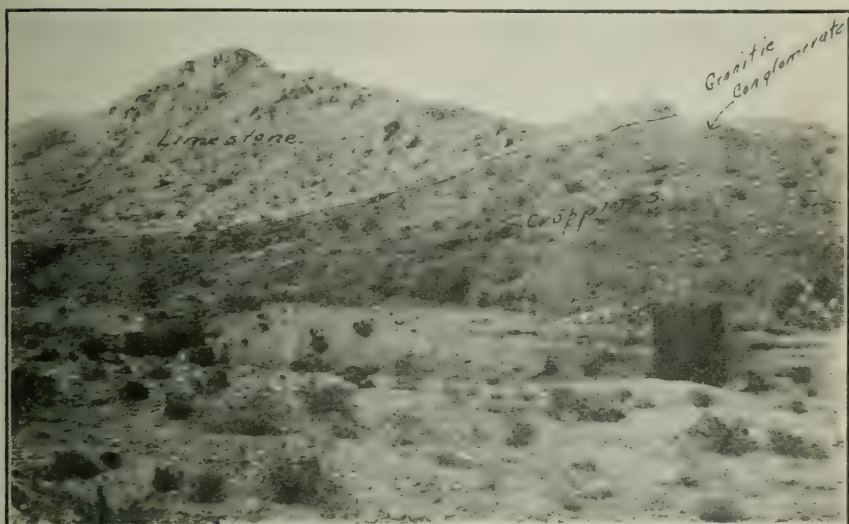


Photo No. 13. Owl's Hole Manganese Mine, San Bernardino County, showing bunkers and glory hole. At contact of limestone and granitic conglomerate.

About one and one-half miles northwest of these workings is an open cut showing four feet of ore. This cut is one-half mile from the wagon road. There is also on the ridge above this open cut, a large manganeseiferous iron outcrop 200 to 300 feet long and about 50 to 75 feet wide. First-class ore as shipped carries 70% MnO_2 and less than 1% of Fe_2O_3 . Second class ore carries about 40% MnO_2 . The ore is trammed from the main shaft to bunkers, where it is loaded in trucks and hauled to Riggs Station.

North of the shaft in an arroyo there is an open cut where the manganese occurs on the contact of limestone and a granitic conglomerate. The croppings at this point are about 50 feet wide and the ore is intermixed with the granitic conglomerate. At the edge of the glory hole a shaft has been sunk to a depth of 60 ft. These workings are on the northeast edge of a wash, the orebody striking N. 45° W. By sorting

the ore from the glory hole and shaft, a good tonnage could be mined from this point.

Owing to litigation, the mine is at present idle. Alexander Yoeman, of Silver Lake, is the owner. An office is maintained at 420 Union Oil Bldg., Los Angeles.

SAN JOAQUIN COUNTY.

For a general description of the San Joaquin County area, see under Alameda County, *ante*, and accompanying map (Plate II).

Crocker Properties. M. I. Crocker, No. 1023 Insurance Exchange Building, San Francisco, owner. These include a number of sections of land in the southwest corner of San Joaquin County, among which manganese has been noted on Sec. 35, T. 4 S., R. 4 E., M. D. M. Undeveloped.

Cummings Lease. See **Winship Properties.**

Ladd Mine. Providence Exploration Co., owner; M. C. Seagrave, manager; Balboa Building, San Francisco. The first manganese mining in California was done in 1867 at this property which is located in Corral Hollow in Sec. 2, T. 4 S., R. 4 E., twelve miles southwest of Tracy. It was opened by A. S. Ladd and worked by him until 1874, during which time about 5000 tons of ore were shipped to England.* In 1874 it was bought by Justinian Caire of San Francisco, but shortly afterwards shipments of California ore to England were stopped by the impossibility of competing with Spanish manganese, so that comparatively little ore was produced for many years. In 1916 it was taken over by Mr. Seagrave, and has since become the largest single producer in the state.

The ore is deposited in a well-defined body between jasper walls, and in previous reports has been described as a filling in a fault fissure. The later and more extensive developments seem to indicate that it is an interbedded deposit with the Franciscan cherts or jaspers similar to the others in this district except that it is more extensive. It strikes N. 10° to 30° W., dipping southwest from quite flat to nearly vertical, the average being 40°. It has been exposed along the strike for about 2000 feet varying in width up to 30 feet, but averaging 4 to 5 feet. The best and largest ore shoots have been found where the dip flattens out. The ore in the main body is the hard massive oxide, black or steel gray in color, and without crystalline structure so that it is impossible to distinguish the particular oxide present, manganite, psilomelane or pyrolusite.

In places the walls are clayey. Here the ore is powdery and soft, blue black in color, and generally intermixed with the clay. In the lower

*Arkansas Geological Survey, Ann. Report 1890, vol. 1.

workings of the mine, below water level in the shaft, and in the lowest tunnel known as the water-tunnel, rhodochrosite, the carbonate of manganese, occurs. This ore, first encountered in the Fabian shaft, was for many years thought to be gangue material and its prevalence there led to the abandonment of the shaft until quite recently.

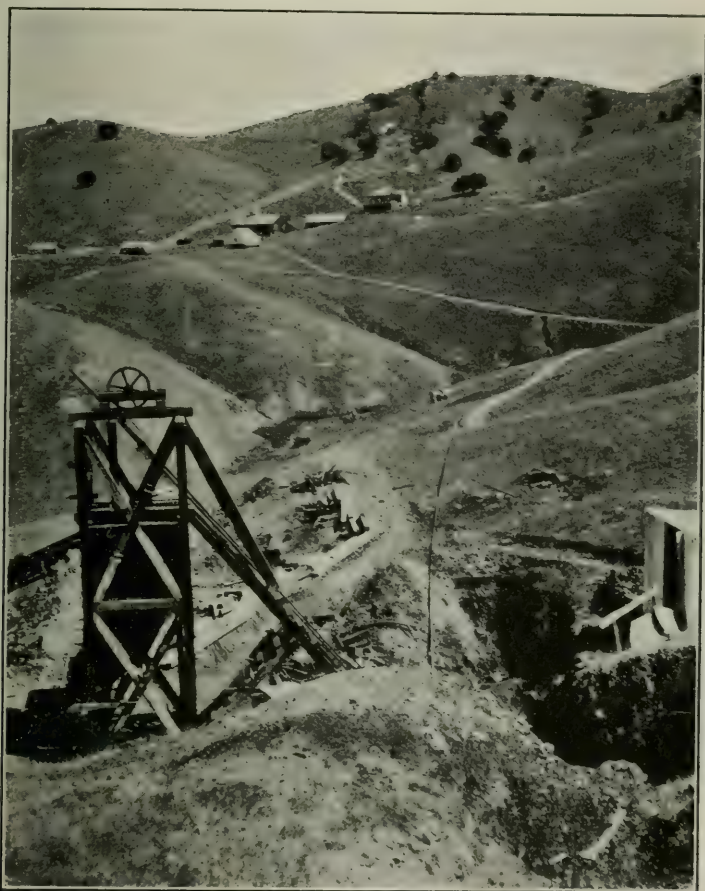


Photo No. 14. Ladd Mine, looking southeasterly from Fabian shaft, showing open cut along strike of orebody.

The presence of the carbonate ore at lower depths indicates that the ore was all originally deposited as the carbonate, but in the zone of oxidation is being reduced to the oxides, as the carbonate ore in the presence of air changes over into the soft black oxide.

The property is developed by three tunnels in the southeastern portion of the section and by the Fabian incline shaft near the north line, the collar of the shaft being 2000 feet northeast of the portal of the

"water" tunnel. The shaft is sunk 100 feet on the vein, which here averages from 3 to 4 feet in width throughout its length. Both the oxides and the carbonates occur here, the latter having been deposited along the clay walls. When visited, the shaft had only been unwatered a few days and no drifts had been driven along the vein. The ore body was being stoped both to north and south from a point about forty feet below collar of shaft. Mr. Seagrave states that this has since been worked out, and proved to be only a lens.

The "water" or "spring" tunnel (main working tunnel) has been driven about 300 feet along the vein, 359 feet in vertical elevation

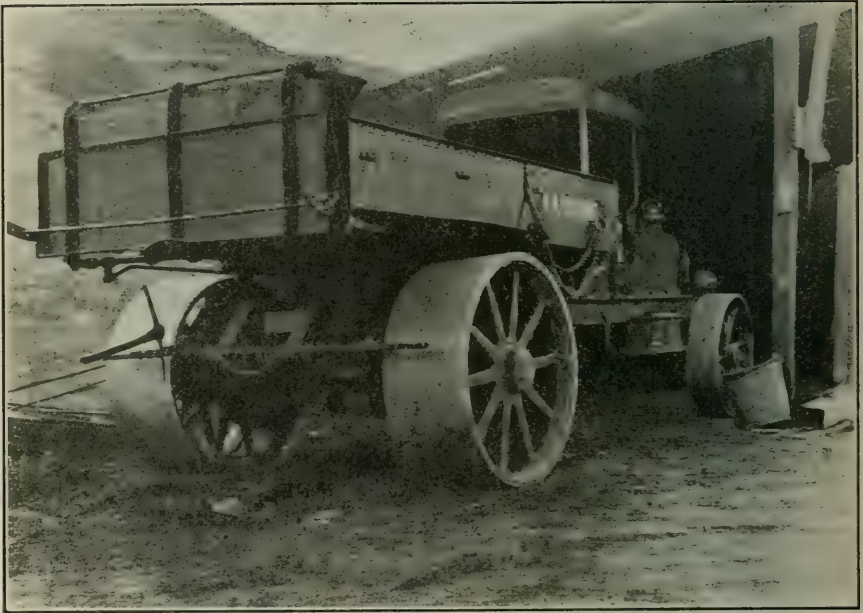


Photo No. 15. White Good-Roads Truck, used by Western Rock Products Company in hauling manganese ore from the Ladd Mine, San Joaquin County. This same truck was used by A. A. Haskins at Hollister for hauling dolomite.

below the croppings, and at about the same elevation as the collar of the shaft. The vein here varies up to 30 feet in width, and the ore is high grade, both carbonate and oxides. Considerable stoping is being done above this level.

The "Red" tunnel is 75 feet vertically above the water tunnel. It was driven to crosscut the vein, and then follows it for 150 feet. The upper tunnel, 85 feet vertically above the middle tunnel is 400 feet long, following the vein. There is an intermediate tunnel between the Red tunnel and upper tunnel, 54 feet along the vein, connected with the upper tunnel by a 40-ft. raise, entirely in ore. From the upper tunnel there is a raise to the surface, but it is not in the vein as the ore

body is faulted here, and offsets several feet. The outcrops have been worked by large open cuts so that little ore remains exposed at the surface. Several thousand tons of high grade ore were blocked out in the mine, when visited, and it has been estimated that there are about 10,000 tons of low grade ore in the dumps, that could be recovered by jiggling.

The ore was hauled from the mine by motor trucks, later by bottom-dump wagons, $1\frac{1}{2}$ miles to the crushing and screening plant, at Manganese Siding on the Tesla branch line of the Western Pacific Rail-

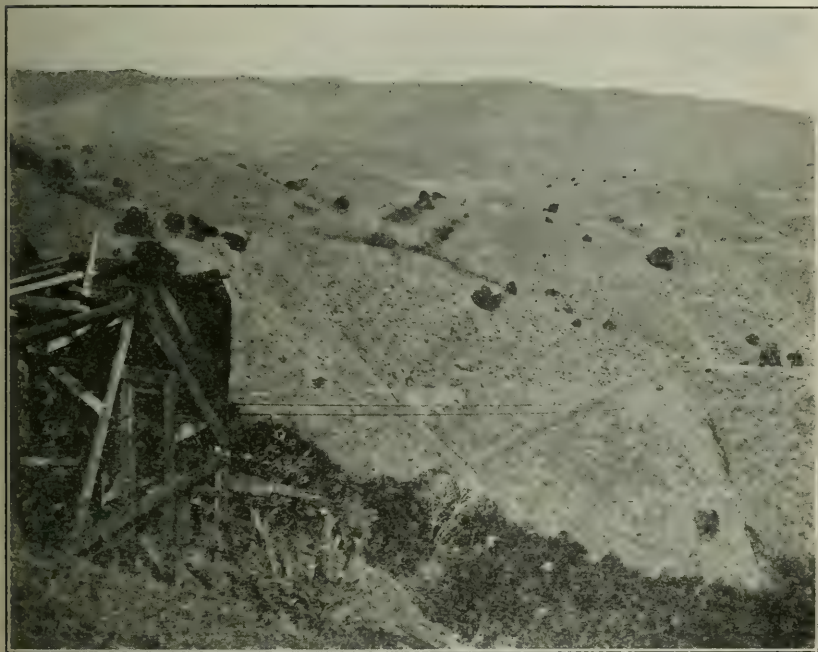


Photo No. 16. Aerial tramway on Sec. 13, T. 4 S., R. 4 E., M. D. M., San Joaquin County, used by Manganese Company of California.

road. The capacity of the plant is two tons per hour, the finest ore shipped to glass factories, and the coarse ore to steel companies. The production averages about 25 tons daily with forty men employed.

Bibl.: Repts. X, p. 564; XIII, p. 507; XIV, p. 620. U. S. G. S. Bul. 427, p. 166. Arkansas Geol. Surv., Ann. Rep. 1890, Vol. I.

Wiltsee Lease. See **Winship Properties.**

Winship Properties. K. D. Winship, 350 Post Street, San Francisco, owner. These include a number of sections of land in the southeast corner of San Joaquin County, on some of which manganese ore has been developed and shipments made. The following contain manganese mines or prospects: Sec. 3, 11, and 13, T. 4 S., R. 4 E., and Sec.

19, T. 4 S., R. 5 E., M. D. M. The above-noted Sec. 11 adjoins the Ladd Mine on the south, and apparently the Ladd vein system extends into it. Across on the south side of the cañon, opposite the Ladd mine, a tunnel was driven in about 100 ft., on a manganese lead which outcrops on a ridge about 50 ft. above it. There are two or three short



Photo No. 17. Stope in manganese mine (Winship)—Wiltsee Lease—Sec. 13, T. 4 S., R. 4 E., M. D. M., San Joaquin County, southeast of Tesla.

crosscuts and one small stope from which some ore was shipped under the Doak Lease in 1915. There is a chute 17" wide which carried the ore to a wagon road in the bottom of the cañon. On a ridge above the tunnel there are two parallel outcroppings, a few feet apart from which ore has been taken out in shallow, open cuts. About 100 ft. westerly there is a small outcrop of promising looking material, but no work has as yet been done on it.

On Sec. 13, above noted, the Manganese Company of California (Wiltsee Lease) did considerable work during 1916, including roads, aerial tram, and underground developments. The tramway is gravity operated, one bucket on each rope, the loaded one raising the empty to the loading bin, and crosses a deep cañon, saving at least two miles of wagon road. See Photo No. 16.

The mine workings consist of about 800 feet or so of drifts and crosscuts, and a stope up to 25' or 30' long, extending from the surface down to a depth of approximately 150'. The stulls supporting it are up to 10' in length. See Photo No. 17. This particular lens of manganese ore, so far as developed, appears to have been worked out, the material left around the edges being somewhat mixed with silica, and narrower in width. The strike of the "vein" in the stope at the surface is approximately N. 20° E., and has a dip about 70° NW. Judging from occasional bits of ore lying about, some high grade manganese must have been shipped out from here. Along the ridge a short distance to the right from the present workings are some outcroppings of manganiferous chert. Though this particular lens appears to have been worked out, there is no reason to believe that others like it may not be opened up with further exploration work. In fact, in practically all of this Tesla-Franciscan district, the manganese ore, where found in commercial quantities is in recurrent lenses.

Both of these sections are at present (November, 1917) under lease to James J. and Frank E. Cummings, Livermore, who have begun shipment from Sec. 13. They report having opened up another lens of ore (or a continuation of the other) by crosscutting. They also have a lease on Sec. 3, T. 4 S., R. 4 E., on Corral Hollow, Alameda County; also on Sec. 17 and 19, T. 5 S., R. 6 E., on the South Branch of Ingram Creek, Stanislaus County.

SAN LUIS OBISPO COUNTY.

Small deposits of manganese ore have been noticed from time to time in the western part of the county, but the price of ore, previous to the war, did not justify any systematic investigation, and practically no work was done to prove the availability of the deposits. (See Plate III.) Recently the attractive price and strong demand have led to the opening of two properties which are now producing on a small scale, and other prospects are now being developed.

The manganese occurs as oxides, both hard and soft, but apparently the best of the ore is largely psilomelane, near the surface and hausmannite at greater depth. It occurs as irregular shaped bunches and as seam fillings in the Franciscan chert. The chert lentils are common on the east slope of the San Luis range from the line of the Pacific Coast railroad northwestward and also along the west slope of

the Santa Lucia Mountains through the entire length of the county. Known deposits of manganese are widely distributed in both these Franciscan belts, and other deposits may be reasonably looked for wherever the chert is found. The known occurrences are rather small and some show a high content of silica. The chert in the vicinity of the ore pockets is usually stained black, giving the impression of greater bodies of ore than really exist.

Evans Manganese Prospects. W. & J. Evans, San Simeon, owners. There are two prospects located on steep hills above San Carpojaró Creek, one in Section 3, T. 25 S., R. 6 E., and the other two miles distant. While only a short distance from the ocean, the ore would have to be taken down steep slopes to reach the road which follows the bed of San Carpojaró Creek, and there would be a haul of five and seven miles, respectively, to the creek's mouth, with some road repairing necessary before hauling could be done. San Simeon is about 12 miles from the mouth of the creek, over a fair road.

The J. Evans prospect shows manganese oxides in a jasper lens 100 feet in width, with a strong outcrop that can be traced for a considerable distance on the surface. The strike of the lens is N. 60° E., and the cropping is heavily stained with manganese for a width of 60 feet. Several shallow holes have been sunk along the outcrop, in which some manganese ore apparently carrying a good deal of silica shows. The W. Evans prospect shows a pocket of manganese oxides five feet wide. Recent assays indicate 48% and 37% metallic manganese, respectively, with 8% silica. A previous assay indicated much less manganese and a very high silica content. As noted elsewhere, the manganese oxides are in bunches, which grade into material stained black, which resembles ore but is nearly all silica. An investigation of such deposits must take into consideration the size of ore pockets. Probably there is some good ore in most of the manganese deposits in the county; but the factors which will determine their availability for mining are the size and distribution of the bunches of ore.

Hearst Ranch Prospect. This is a newly found deposit of manganese oxides in chert. It is located on the Hearst property on San Simeon Creek, three miles from the wharf at San Simeon. A good showing is reported, but no analysis has been made. Because of the short haul to the steamer, it is believed that the prospect will be opened immediately by the owner's agents, with a view to shipping if ore is developed.

Hobson Claims. W. K. Hobson of Cayucos has several claims originally located for copper and chrome on which there is a cropping of chert, or jasper, 10 to 15 ft. wide. The jasper strata contains

bunches and coatings of manganese oxides. The claims are 8 miles east of Cayucos on the west side of the Santa Lucia range between Morro and Toro creeks. It is probable that this deposit is a continuation of that found on the Phelan ranch, near Cambria, and described later.

Johe Ranch Deposit. On the George M. Johe Ranch in Clark Valley, some large boulders of float have been found in a cañon one-half mile east of the ranch house. The property is ten miles southwest of San Luis Obispo. Five men are employed in prospecting for ore in place. The mineral rights have been leased by the California Manganese Co., 180 Sutter Street, San Francisco. No ore has been shipped yet, but an assay indicates 78% MnO_2 and $1\frac{1}{2}\%$ silica, which probably represents the very best of the ore.

Phelan Ranch Deposits. These deposits are on patented agricultural land and are owned by Phelan L. & C. Co.—R. and Jeff Phelan, post office, Cambria. They are situated in the Pine Mountain district, in T. 27 S., R. 8 E., 8 miles from Cambria, the nearest town, and 34 miles from San Luis Obispo. It is six miles from the ranch house to the deposit. Deep water transportation is found at San Simeon, about 10 miles distant. The deposit occurs as a bold outcrop on the slope of a hill and as float on top of the hill. The elevation is 1700 ft. A strata, or lens of blue, red, brown and green jasper 12 ft. in width strikes N. 50° W., and dips 20° to 40° north. Three prominent outcrops of manganese oxides in irregular masses of comparative purity, alternate with chert or jasper and all percentages of silica and manganese oxides are exposed in the croppings along the vein for 200 yds. The float ore found on the top of the hill above the vein exposure may indicate folding or flattening of the vein, or another parallel lens. Recent assays of samples from this deposit indicated a high silica and low manganese content, but the haphazard method by which some of the manganese prospects in the county are sampled, make it unsafe to place much reliance on the results obtained.

Riccioli Prospect. Victor Riccioli, Cayucos, owner. Located one-quarter mile from the road between Cayucos and Cambria, and seven miles southeast of the latter. The prospect is very well located for mining and is within 28 miles of the railroad at San Luis Obispo. The chert outcrop strikes northwest and carries irregular shaped masses of mixed manganese oxides in three places. There are two bunches of apparently fair grade material with a maximum width of $4\frac{1}{2}$ ft. at the surface. These outcrop about 50 feet apart, and there is probably some ore under the surface between them. The manganiferous outcrop is about 100 feet long here. Signs of manganese in the chert along the strike to the southeast, and in a stream canyon to the northeast, have been noted but not prospected. A little drilling has been done on the

two bunches mentioned above, but they have not been uncovered, and no work has been done along the outcrop to determine the continuity of the deposit. This property has been leased (April, 1918) by J. A. Faucher et al., of Oakland, and a small force will be put to work at once. Two picked samples assayed by A. A. Hanks showed 56% and 51% manganese, with silica not determined. A previous sample, said to carry more than the allowable percentage of silica, may have come from the leaner portion of the chert, which is stained black for several feet on each side of the ore pockets.

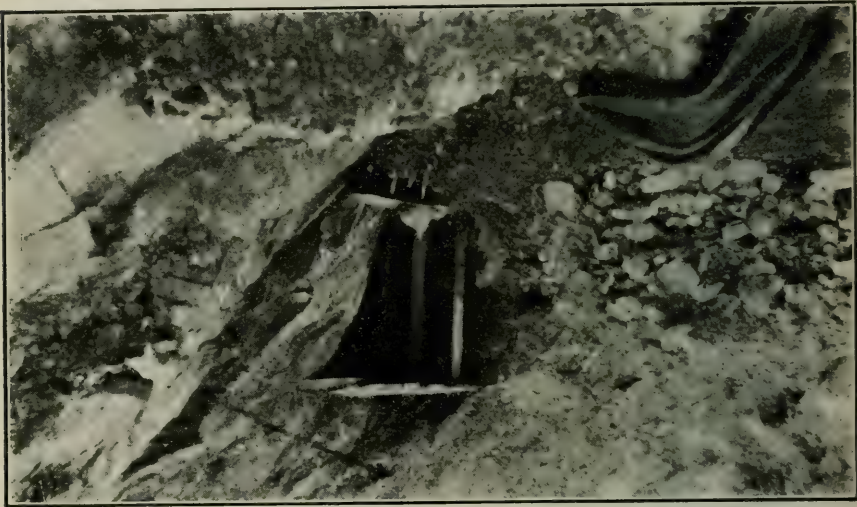


Photo No. 17a. Staneuch Ranch, or Prefumo Cañon Manganese Deposit, San Luis Obispo County, showing lower tunnel. Manganese Company of California, lessee.

Staneuch Ranch Deposit. The mineral rights on 200 acres of this ranch have been leased by the Manganese Co. of California, 180 Sutter Street, San Francisco. Mining of manganese ore is going on at three places on a steep hillside, the highest opening being about 850 feet above sea level. The property is in the Prefumo Cañon district, west of San Luis Obispo, to which place the ore is hauled over eight miles of good road. The original strike of the chert lentil has been disturbed by sliding and the seams of ore cross it transversely as well as parallel to the strike. The mine workings are small. The largest bunch of ore taken out so far was ragged and irregular in shape, with a height of ten feet and width of one to four feet, high grade enough to ship. Several carloads have been shipped. Three tunnels at different elevations below this opening, are being driven to develop similar showings, and several short tunnels are also being put into a steep hillside a mile distant where open cuts revealed ore in bunches over a distance of 500 feet.

The best ore noticed was blue-black, has a hardness about 5 to 5.5, and a conchoidal fracture. It was probably mostly psilomelane, although it is said that considerable soft ore is found also.



Photo No. 17b. Staneuch Ranch, or Prefumo Cañon Manganese Deposit, showing tunnels on slope of ridge.

The following analyses of ear samples by Geo. A. James show the quality of ore from two places where mining is going on:

East side of cañon.

West side of cañon.

Manganese sesquioxide -----	8.8	Manganese -----	49.4
Manganese dioxide -----	78.1	Silica -----	6.8
Iron sesquioxide -----	3.04	Manganese dioxide -----	60.0
Moisture -----	2.1		
Organic matter -----	0.4		
Calcium carbonate -----	0.22		
Copper oxide -----	0.094		
Silica -----	3.32		
Alumina -----	.60		
Magnesia -----	Trace		
Water -----	2.4		
Phosphorus -----	.28		

Results obtained here indicate in a general way what may reasonably be expected from similar prospects in the county.

Welsh Ranch Deposit. On Welsh Ranch, eight miles west of San Luis Obispo, a deposit of manganese has been discovered in Lot 74 of Rancho Los Osos. On a ridge south of Clark Valley Creek, a large lens of jasper outcrops from 300 to 500 yards long. The manganese ore occurs as three parallel veins, with a north and south course. The ore in this lens is exposed in three tunnels and several surface workings. In a tunnel on the west end of the jasper lens, a

thickness of two and a half to five feet of manganese ore has been exposed. This vein dips 40° E. Above the tunnel, the vein has been exposed for a distance of several hundred feet.

A couple hundred feet east of these workings, in an open cut, another vein of manganese ore has been exposed, showing five feet of manganese oxides. At a lower elevation, a tunnel is being driven south to develop the ore exposed on surface. About 300 feet east of these workings, another vein has been exposed by a short tunnel and open cut. The vein has a thickness of five feet and strikes north and south with a dip to the east. The ore is a black oxide and occurs as a coating of

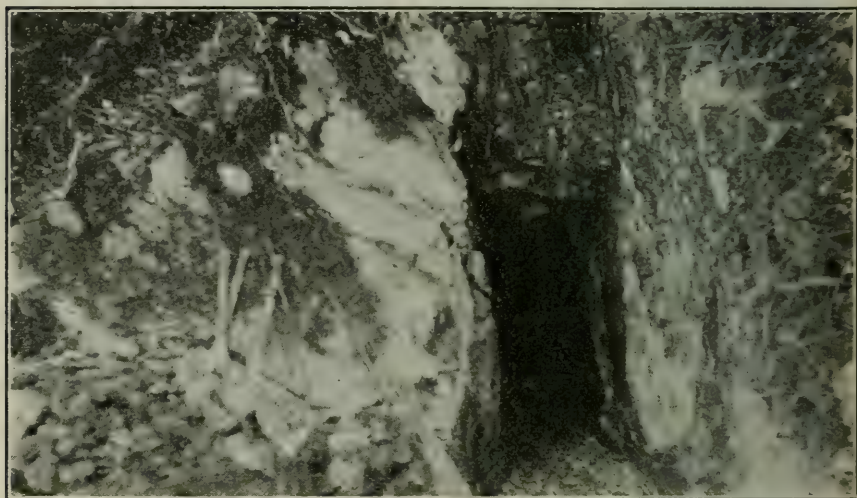


Photo No. 17c. No. 1 Tunnel of Welsh Manganese Deposit, Clarke Valley, San Luis Obispo County, showing 5' vein of manganese. Noble Electric Steel Company, lessee.

seams and as nearly pure masses in the jasper. Thirty men are employed on development work and in constructing roads. Owner, Welsh Estate, San Luis Obispo. Under lease to Noble Electric Steel Company.

Bibl.: U. S. G. S. Folio 101, H. W. Fairbanks; Bulletin 427, E. C. Harder; California State Mining Bureau, Mines and Mineral Resources of San Luis Obispo and other counties, 1916.

SANTA BARBARA COUNTY.

Manganese ore deposits in Santa Barbara County are of small dimensions. A few occurrences have been noted, but they remain undisturbed.

La Laguna Ranch Deposits. The La Laguna Ranch Company, W. M. Bradley, Secy., 320 Chamber of Commerce Bldg., Pasadena, Cal., is the owner of this property, which is located 10 miles northeast of Los Olivos, two miles beyond and north of the Cavanaugh Ranch,

From the latter ranch there is a good wagon road eight miles in length to Los Olivcs, where the nearest rail connection is found.

On a ridge northeast of Figueroa Cañon a number of small chert or jasper lenses outcrop. The most noticeable ore occurrence is along a jasper lens, striking east and west where manganese minerals are exposed in several places. They are the usual commercial ore minerals and appear to be of good grade, but as the jasper lenses are small, there does not seem to be any extent to the deposit. A sample of ore from the outcrop ran as follows: MnO_2 70.62%, metallic manganese 45.5%, silica 12.35%. No development work has been attempted.

SANTA CLARA COUNTY.

Manganese ores occur in that mountainous region in the extreme northeast corner of the county, the deposits being similar to those found in the bordering counties, Alameda and San Joaquin, previously described in this report. Access to this region is gained from Livermore by a good auto road, which follows the Arroyo Mocho, or from Patterson in the San Joaquin Valley, by the Patterson and Western Railroad, a narrow gauge road, constructed to haul ores from the Black Wonder Mine (see below). See also map (Plate II) under Alameda County, *ante*.

Comparatively little ore has been shipped from the various deposits, and they are mostly prospects which have been worked only to a very limited extent.

A huge boulder of manganese lies on Penitencia Creek, just below Alum Rock Park. This boulder, labelled by the City of San Jose "meteorite" was at one time thought to be the outcrop of a large vein. The main ledge or body from which it came has never been discovered and it is probably in the mountainous region at the head of the cañon.

The Ala Mountain Mine is 26 miles southeast of Livermore in Sec. 28, T. 5 S., R. 4 E., M. D. B. & M. A body of manganese ore about four feet wide was exposed by an open cut and short tunnel, and some ore hauled to Livermore, years ago. No work has been done here recently. The Merchant Estate of Livermore is the owner.

Bibl.: Bull. 38, p. 336.

Black Bear Mine, 25 miles southeast of Livermore, is in Sec. 34, T. 5 S., R. 4 E., near the summit of the west slope of the Arroyo Mocho Valley, at an elevation of 3100 feet. Interbedded lenses of manganese ore occur in the jasper, some of them being 3' in thickness and fairly extensive. Development consists of several open cuts and tunnels. The property has been idle for several years. D. P. Doak, Rialto Bldg., San Francisco, is the owner.

Bibl.: Bull. 38, pp. 336-337.

Black Bird Prospect is in the center of Sec. 28, T. 6 S., R. 5 E., and is owned by the Mineral Products Co. When visited, some small pits had been sunk, but no production had been made.

The Black Wonder Properties comprise the Jones Group in the NW. $\frac{1}{4}$ of NE. $\frac{1}{4}$ of Sec. 27; the Black Wonder in the SE. $\frac{1}{4}$ of SE. $\frac{1}{4}$ of Sec. 27; and the Mexican Prospect, in SW. $\frac{1}{4}$ of SE. $\frac{1}{4}$ of Sec. 27, T. 6 S., R. 5 E., near the Stanislaus County boundary. It was formerly the property of the California Manganese Mining Company, of which Howard A. Broughton was President, and is now owned by the Mineral Products Company, with offices at 334 Rialto Bldg., San Francisco. This company, organized in 1915, is developing the property in connection with its deposits of chrome in Stanislaus County. A narrow gauge steam railroad, called the "Patterson and Western," was constructed from Patterson 23 miles up the Cañon del Puerto to the foot of Red Mountain, where Camp Jones has been established. Here it connects with a 2 ft. gauge gasoline tramway, five miles in length, which runs to the Jones Mine near the top of the ridge at an elevation of 2750 ft., almost 1000 ft. above the terminus of the Patterson and Western Railroad.

The manganese deposits on this group of claims are the most promising ones thus far discovered in the county, and their occurrence has been described in Harder's report* as follows:

"The southern part of the area covered by the claims is greenish-gray sandstone of the Franciscan formation; the northern part is a mixture of jasper and fine shale interbedded. This jasper area extends in a general east-west direction three or four miles between the sandstone on the south and a large area of serpentine on the north. Where the principal manganese ore deposits occur the jasper shale belt is about a mile wide. The manganese ores extend as discontinuous deposits along the jasper belt for more than a mile in a general northwest-southeast direction, the principal deposits being to the southeast and very near the sandstone contact.

"The jasper-shale formation consists of beds and lenses of jasper interbedded with fine shale. The jasper may be thin-bedded or very heavy bedded, in the last case forming prominent outcrops. The beds generally strike in the direction of the main jasper belt, but the dips are exceedingly irregular.

"The manganese ore occurs along heavy jasper beds. * * * The principal deposits, that is, those at the southeast end, are found along two or three prominent jasper beds 300 to 500 yards long, which are nearly parallel and 50 to 200 feet apart, separated by thin-bedded jasper

*Harder, E. C., Manganese deposits of the United States: U. S. G. S. Bull. 427, pp. 162-162, 1910.

and shade. Of these, the deposits in the bed farthest south are most prominent.”

Development work consists of two tunnels and several small open cuts. At the Jones Mine, the tunnel is in about 50 ft., exposing 5 to 8 ft. of manganese ore with irregular bunches of jasper and quartz. The ore here is bluish black, soft and high grade. About 40 tons of it were lying at the foot of the tramway, ready to be hauled to Patterson. At the Black Wonder claim, a tunnel was driven on the ore body, but it was caved. The croppings here show a body of hard, black amorphous ore, with numerous intersecting jasper and quartz seams. Twenty men were employed working at various places on the claims. The Black Wonder lies over a mile to the south of the Jones Claim, at an elevation of 3050 ft. Only a trail connects the two.

The company erected at Patterson a factory for the manufacture of manganese dioxide, but later developments led them to abandon this idea and according to last reports the plant is to be utilized for making hydromagnesite.

Considerably more development work is necessary to determine whether this property will prove a large producer. The company's officers are: A. F. Judd of Honolulu, president; C. G. Bokus, secretary; Robert Anderson, 334 Rialto Bldg., San Francisco, General Manager.

Bibl.: U. S. G. S. Bull. 427, pp. 162-163.

Camp Bessie Mine. See **Fable Manganese Mine.**

Davenport Prospect is on the Winship properties near the center of the north line of Sec. 27, T. 5 S., R. 4 E., one-half mile east of the Arroyo Mocho Road and $25\frac{1}{2}$ miles from Livermore. Rather siliceous manganese oxide occurs in chert which strikes N. 70° W., and dips 65° S. When visited only one prospect hole five feet deep had been sunk.

Davenport and Smith Prospect is on the Winship properties in the NE. $\frac{1}{4}$ of Sec. 27, T. 5 S., R. 4 E., one-half mile from the Arroyo Mocho Road and 25 miles from Livermore. At the extreme northwest end of the claim an inclined shaft follows the ore on its dip southwest for 25 feet. Southeast of this, ore is exposed in trenches. Ninety feet southeast of the shaft there is a drift running nearly northwest along the strike of the ore body. Southeast still farther more trenching has been done, and finally, at the extreme southeast end, 300 feet from the shaft, a short tunnel exposes as much as five feet of massive siliceous manganese oxide striking N. 50° W., and dipping 25° to 75° S. W. This body is considerably broken by minor shearing, and varies in width, averaging possibly two and one-half feet.

Doak Mine No. 2. It is in the Red Mountain District, 25 miles southeast of Livermore on the Camp Bessie Road, in Sec. 22, T. 5 S.,

R. 4 E., M. D. M. A few open cuts and short tunnels have been driven on some heavy croppings of manganese-stained jasper, developing a vein of manganese ore said to be four feet in width. A few tons of ore were produced from this deposit, but it is now idle. D. P. Doak of San Francisco, is the owner.

Bibl.: Bull. 38, p. 337.

Fable Manganese Mine, in S.W. $\frac{1}{4}$ of N.E. $\frac{1}{4}$ of Sec. 34, T. 5 S., R. 4 E., is in a small cañon tributary to the Arroyo Mocho, about 26 miles southeast of Livermore. The ore, a soft, black oxide, is deposited in an irregular layer varying from 6" to several feet thick, interbedded in greenish-gray jasper, which has a strike a little west of north, and a dip of 45 degrees to the southwest. Development consists of a series of open cuts along the outcrop and a 100 ft. tunnel driven on the vein, showing six feet of ore. An incline shaft located near mouth of tunnel was sunk on vein to a depth of 18 feet, but it is now filled up. Idle. Thomas Green of Dublin, Cal., is the owner.

Bibl.: Cal. State Min. Bur. Bull. 38, p. 337; U. S. G. S. Bull. 427, p. 162.

Keller Bros. have a slightly developed prospect of manganese in Sec. 13, T. 6 S., R. 4 E., in San Antone Valley. No ore had been developed when the property was last visited.

Mammoth Prospect is owned by H. H. Ballantine and leased to John Plattner. The claim is in Sec. 13, T. 6 S., R. 4 E., three-fourths of a mile east of a point which is 32 miles from Livermore on the Arroyo Mocho Road. Several open cuts expose three to six feet of massive, rather siliceous manganese oxide in chert. No production is reported.

Mineral Products Co. owns two unnamed prospects one-half mile east of the Black Bird Prospect, near the east line of Sec. 28, T. 6 S., R. 5 E. Large, angular blocks of oxides of manganese occur here. A little work has been done. In the NE. $\frac{1}{4}$ of the same section a trench 60 yards long has been made and a small amount of oxide ore is exposed. No recent work has been done here.

Mateos Ranch Deposit. It is in Sec. 8, T. 6 S., R. 2 E., eight miles by road east of Milpitas, in Alum Rock Cañon, about two miles beyond the park. There is no road connecting with the terminus of the electric railway at the park, so that, at present, the ore has to be hauled over a mountainous road eight miles to the railroad station at Milpitas. A connection with the Alum Rock Cañon road could be made by constructing one-half mile of road.

The manganese ore occurs in seams and pockets in the jasper beds. Considerable high grade float is found in the cañon and a few large

boulders aggregating several tons in weight, are lying in a small ravine near junctions with the main cañon. The ore, however, is intermixed with the jasper, and consequently low grade.

A tunnel was driven 40 years ago in the jasper beds, and it is reported that some high grade ore was shipped. It is now caved and inaccessible. About 200 ft. west of the tunnel and at the same elevation, an open cut was made last year and about 40 tons of ore was shipped. The face of the cut is caved, so that no ore is at present exposed. Judging from the amount of float found in the cañon and the extent of the manganese stained croppings, the property appears favorable for further development. It is idle. John D. Mateos, 165 N. Fifteenth St., San Jose, Cal., is the owner.

Newhall Mine ("Great Expectations" Claim), E. P. Newhall, Box 354, Livermore, owner; Horace B. Chase 57 Post St., San Francisco, lessee. It is in Sec. 36, T. 5 S., R. 4 E., on the headwaters of Colorado Creek, a branch of Black Bird Valley 29 miles southeast of Livermore. Some development work had been done by the owner; but he has recently (November, 1917) leased the property. The lessee has some ore out ready to ship showing both carbonate and oxide and said to analyze 42% manganese. The mine is three miles by wagon road from the main Arroyo Mocho Road leading to Livermore. The ore is reported to show three feet in width.

Pennsylvania Manganese Mine. The property comprising two unpatented claims is in SE. $\frac{1}{4}$ of Sec. 12, T. 7 S., R. 4 E., 35 miles southeast of Livermore via the Arroyo Mocho Road. The jasper beds with interbedded lenses of manganese ores outcrop for about 500 ft. along the strike, which is northwest, in places showing high grade ore. Development work consists only of a few trenches along the outcrop. About 100 tons of ore, which appears to run high in silica, is lying on the several dumps. The property is worked for assessment only, and the owner is willing to lease on a royalty basis. Sufficient work has not been done to justify an opinion as to its importance. Morgan M. O'Day, 58 N. Fifteenth St., San Jose, is the owner. The Noble Electric Steel Co. leased this property but discontinued work after shipping some ore.

On the **Wallace Ranch**, in Section 8, T. 6 S., R. 2 E., $6\frac{1}{2}$ miles by road east of Milpitas, a small cropping of high grade manganese ore was observed. This deposit adjoins that of the Mateos Ranch, to the northwest, and is evidently a continuation of the same beds. The jasper here outcrops prominently in bold ledges over large areas, but for the most part it is free from manganese stainings. The only ore observed in place was that exposed for a width of 12" in a small cut, about 100 ft. in elevation above the old tunnel on the Mateos Ranch. Ore taken

from this deposit is reported to have assayed 50.8% metallic manganese. It is undeveloped. Mrs. Grace P. Wallace, 164 East San Carlos St., San Jose, is the owner.

Winship Properties. K. D. Winship, 350 Post Street, San Francisco, owner. In the northeast corner of Santa Clara County, in the upper part of the Arroyo Mocho, these properties include the following sections containing manganese prospects: Sec. 27 and Sec. 35, T. 5 S., R. 4 E., M. D. M.

In the SW. $\frac{1}{4}$ of Sec. 27, on the west side of the Red Mountain-Livermore road, at a point well above and easily accessible to the road is a series of manganese veins covering a width of about 50'. These croppings are traceable for a distance of at least a couple hundred yards long, running west of north. It could probably be followed much farther, but the chamise brush is very thick at this point. A little work was done some years ago around these outcroppings, and it is stated a few tons of high grade ore hauled out. Material from there could be easily handled by a gravity tram to a loading point on the Arroyo Mocho road.

On the NE. $\frac{1}{4}$ of this same Sec. 27, is a good prospect of manganese ore. Some work was done a few years ago, said to have been by the same parties who worked on the SW. $\frac{1}{4}$. A short tunnel, now caved, is stated to have cut through a 4' vein of high grade ore. The surface indications are that it is at least that wide. The strike is west of north. There are other exposures on this same lead, to the south for about 200'-300'. This deposit is on the east side of the Arroyo Mocho road in an ideal location for a gravity tram to handle the ore to bunkers. In April, 1916, E. A. Wiltsee took a lease on these deposits on Sec. 27 and did a little preliminary development work, but nothing further. Holbrook & McGuire, as sub-lessees, shipped a couple carloads of manganese ore from this section in 1917, but are not now, (December, 1917) working.

SHASTA COUNTY.

The Pit River Consolidated Group of claims is located in Sec. 36 of T. 34 N., R. 4 W., and in Sec. 1 of T. 33 N., R. 4 W., M. D. M. The property lies at an elevation of 730 feet, about 1 mile southeast of the Heroult smelter. The deposit consists of the oxide of manganese filling the fissures and joint planes in a fractured schist, and no well defined ore body is exposed. Considerable sulphur is liberated when the material decomposes.

The Noble Electric Steel Corporation recently leased the property, but found that the manufacture of silico-manganese was unprofitable. Development work consists of two tunnels. A main tunnel was

run S. 40° W. with ore chutes at 50' and 75'. Another tunnel running due west was filled with waste. The ore was quarried on the side hill with two faces 20' high and 30' long. The surface was de-soiled for a distance of 50' up and 100' along the hillside. Equipment consists of a 50-ton ore bin built of logs, a shop, and ties left from the dismantling of one mile of tramway which led to the smelter.

The property is owned by the Shasta Copper Company, of which Sherman T. White is President with office at 29 Swansey Building, 414 Yuba Street, Redding.

SISKIYOU COUNTY.

Manganese oxides mixed with high proportions of silica have been observed at different places in the Salmon River watershed. Their occurrence is possible anywhere in the chert belt which crosses the Salmon drainage from Tanner's Peak to the New River divide. The oxide ores have the same mineralogical character and geological associations as the ores found farther south in the Franciscan cherts of the Coast Range. Such outcrops were noted on the top and sides of the Blue Ridge at an elevation of 5600 feet, but the exposure there contained a great deal of silica as did those noted on the trail along the South Fork of Salmon River.

Dr. W. W. Barham, Yreka, reports he has made locations on a body of somewhat siliceous manganese oxides in Sec. 9 or 16, T. 44 N., R. 8 W., southwest of Yreka. It is near a wagon road, and 11 miles from the railroad. The manganese-bearing material is 10 feet wide. Undeveloped.

Davis Prospect. Reeves Davis, Happy Camp, has a manganese prospect 8 miles above Happy Camp and one mile east of Indian Creek. A seven foot body of manganese ore is reported but no development work has been done, and the quality of material has not been determined.

Dozier Deposit, M. Dozier, owner, Los Angeles. In Sec. 15, T. 46 N., R. 6 W., M. D. M., 6 miles southwest of Klamathon, between Montague and Hornbrook, there is stated to be a large deposit of siliceous manganese oxide (30% SiO_2 and 37% Mn) which would be suitable for making silico-manganese in the electric furnace. In May, the Noble Electric Steel Company of San Francisco was reported to have an option on this deposit, but so far as the author is aware, no ore has as yet been shipped.

Manganese oxides somewhat siliceous are reported in quantity on the ridge north of Greenview and southeast of Oro Fino, in Secs. 20 and 21 (?), T. 43 N., R. 9 W., M. D. M. Undeveloped.

Skillen & Means Group. G. G. Skillen and Millard Means of Sawyers Bar have three manganese claims near the head of Callahan Gulch in T. 39 N., R. 11 W., two miles from a point where the road to Black Bear crosses the summit bearing the same name. The claims lie end to end. Skillen reports a manganese-bearing outcrop 1600 feet long as lenses alternating with silica over a total width of 150 feet. No assays of the material have been made and no development work done. The prospect is about 53 miles from the railroad at Yreka, with a summit 6159 feet high intervening. A wagon road, which crosses the summit is in good condition in the summer months and passes within two miles of the prospect.

SONOMA COUNTY.

Very few workable deposits of manganese ores have been found in this county. There are a number of localities where manganese oxides occur, but usually they are deposited merely as stains and small pockets in the jasper. In fact, most of the jasper beds seen were stained more or less with the manganese oxides.

Wm. Hunter of Cloverdale mined and sold several carloads of manganese ore in 1917 from a deposit not visited by the field assistant. The location of the property was not stated.

W. J. McLean and **C. F. Clark** of Calistoga report an undeveloped manganese prospect at Pine Flat, 22 miles by road from Healdsburg.

Shanks and Copps Lease. This deposit is located in a precipitous cañon 9 miles by road west of Geyserville, and 2 miles east of Skaggs Springs. It was first opened by the Noble Electric Steel Company, who it is reported took out about 500 tons of high grade ore during 1916. The ore, psilomelane and pyrolusite, is deposited in a well defined ledge between jasper walls. It strikes northwest, dipping vertically, and the croppings can be traced over the ridge for 500 ft., varying in width from 3 to 5 ft. An open cut and tunnel, now 30 ft. long, is being driven on the ledge at the foot of the cropping. By driving this tunnel at its present level, it will give a back of 300 feet, providing the ore body persists with depth. The tunnel is entirely in ore and the body at the face is 6 ft. in width. The ore produced by the Noble Electric Steel Company was mined from a deposit which appears to have been faulted from the main ledge, as it lies with a very slight dip about 100 ft. below and west of the main body. It has practically been exhausted as only a stringer of the powdery black dioxide remains in the bottom of the cut. This property was taken over in the early part of May, 1917, by the present operators, and they produced three cars of ore, which is reported to have run from 42% to 50% metallic manganese, and 4% to 14% silica. It was hauled to the railroad at

Geyserville at \$3.50 per ton. Five men were employed. Under lease to D. W. Shanks* and A. W. Copps, 1302 Merchants National Bank Bldg., San Francisco. K. K. Ash is Superintendent. S. R. Boyer of Geyserville is the owner.

Shaw and Matthews Manganese Mine. It is in Section 31, T. 12 N., R. 11 W., 7 miles northwest of Cloverdale, along the top of a ridge at an elevation of 850 feet. An old wagon road about 1 mile long connects it with the Hopland-Cloverdale highway. It was first opened about 30 years ago by J. E. Shaw of Cloverdale, who shipped 20 tons of high grade ore. It then lay idle up to last year when a lease was taken on it by Michael, Roman and Weeks of San Francisco. They worked only a short time and abandoned their lease as the ore was too low grade to be profitably handled. It is now idle. The jasper beds here outcrop for over a mile, showing manganese oxide stains at many places. The development work consists of an open cut 20' by 40' at the heavier stained beds, showing $4\frac{1}{2}$ to 6 ft. of manganese oxide outcropping for 45 ft. along the strike of red chert and shale which strike N. 15° E. and dip 70° S.E. About 50 to 60 tons of ore have been sacked and are lying on the dump, but the ore appears to contain a high percentage of silica. C. B. Shaw, Cloverdale, is the owner.

Bibl.: Repts. XII, p. 330, XIII, p. 507; XIV, p. 104; Bull. 38, p. 337.

In the vicinity of **Skaggs Hot Springs**, there are extensive croppings of red jasper stained with manganese oxides, but no croppings were observed rich enough in manganese to warrant exploitation. It is very possible that some rich lenses may be discovered at some future date. The mountains here are very precipitous and covered with a dense growth of brush which makes prospecting difficult.

On the **Wheeler Prospect**, 500 feet north of Shanks and Copps Lease, and on the opposite side of the creek, a small amount of good ore had been found when the property was visited.

STANISLAUS COUNTY.

The manganese deposits found in the northwestern corner of Stanislaus County are a southeasterly extension of the belt beginning near Tesla¹ in Alameda County.

Crocker Properties, M. I. Crocker, 1023 Insurance Exchange Bldg., San Francisco, owner. These include a number of sections of land in the northwest corner of Stanislaus County, among which an occurrence of manganese has been noted on Sec. 33, T. 5 S., R. 6 E. Undeveloped.

*Since this report was written the partnership has been dissolved, and the property was being operated by Shanks in February, 1918.

¹See page 24, *ante*, also map (Plate II).

Cummings Lease. See **Winship Properties.**

Grummit Ranch, W. M. Grummit, owner, via Westley. It is in Sec. 6, T. 5 S., R. 6 E., on the north branch of Ingram Creek; and is under lease to the Manganese Products Company, Alex. J. Knox, manager. They have shipped several carloads of manganese ore the past summer (1917), said to be of medium grade, principally from surface cuts. In August, 1917, they were driving a tunnel. The ore body shows from 18" to 2' in width.

Hugh Phillips also has a lease on another portion of this Grummit section, but on the opposite side of the cañon from the above. In August he had out a few tons of manganese ore which he had taken from surface cuts.

There is a **Manganese Prospect** on Sec. 8, T. 6 S., R. 6 E., M. D. M., on the Arroyo del Puerto, on which some development work has been done. The writer was unable to learn of the owner's name.

Bibl.: Report on M. & M. Res. of Fresno et al. counties, 1915, p. 204; also Report XIV, p. 630.

The Mineral Products Company, Rialto Building, San Francisco, in 1915 took over the holdings of the California Manganese Company¹ in Secs. 9, 11, 15, 21, 22, 27, 28, 33 and 34, T. 6 S., R. 5 E., at the head of the Arroyo del Puerto. This group includes the Black Wonder group mainly in Santa Clara County (see description under Santa Clara County).

Sartorius Lease. See **Winship Properties.****Sperry-Wright Lease.** See **Winship Properties.**

Winship Properties, K. D. Winship, 350 Post Street, San Francisco, owner. These include a number of sections of land in the northwest corner of Stanislaus County, on some of which manganese ore has been developed and shipments made. The following contain manganese mines or prospects: Secs. 1, 3 and 13, T. 5 S., R. 5 E.; Secs. 17 and 19, T. 5 S., R. 6 E., M. D. M.

On Sec. 1, T. 5 S., R. 5 E., on the north branch of Ingram Creek, there are several manganese prospects which are as yet undeveloped. At one of these outcroppings there is a mineralized zone about 6'-8' wide, showing two or three streaks of manganese oxide about a foot wide which may develop into ore. At another point near the west side of Sec. 1, there is a manganese-bearing zone at least 250' in length, running along the backbone of the ridge. There is much loose material on the surface, so that it is difficult to tell how wide the ore may be until at least some preliminary development work is done. There are probably

¹Cal. State Min. Bur., Report on Mines & Mineral Res. of Fresno et al. counties, 1915, p. 204; also in Report XIV, p. 630.

several streaks of ore, principally on the south (left) side of the reef shown in the photograph. There are manganese indications at several other places in this Sec. 1, and some small bunches of ore. Much of it, however, is rather siliceous. A lease was given on this section in August, 1917, and a little work done, but for lack of capital to properly develop it the lessee gave it up.*

In the N. $\frac{1}{2}$ of SE. $\frac{1}{4}$, Sec. 3, T. 5 S., R. 5 E., a deposit of ore is being developed under lease by M. A. Wright of Tracy. This deposit was



Photo No. 18. Manganese prospect on Sec. 1, T. 5 S., R. 5 E., M. D. M., on Ingram Creek, Stanislaus County, owned by K. D. Winship.

discovered by U. G. Sperry of Vernalis, who owns a manganese prospect on an adjoining section. It is 14 miles from Vernalis and 2 miles up Buckeye Gulch, easterly above the wagon road on Hospital Creek. There are at least two manganese-bearing zones on the south slope of the ridge, striking in an easterly direction with dip to the north into the hill. The ore exposures are marked by a number of large boulders of ore. The ore, both in the boulders and in place is the massive black oxide, and much of it is high grade. The following analysis is of a sample taken before development work had been started, by chipping

*Since the above was written, this Sec. 1 has been leased to M. C. Seagrave, Balboa Bldg., San Francisco, who has opened up a body of commercial ore in the NW. $\frac{1}{4}$ [Sept. 1918].

off pieces of ore from various outcroppings and from some of the large boulders:

Analysis of Manganese Ore.*

Constituent	Per cent as received	Per cent water free
Manganese dioxide (MnO_2)-----	62.56	70.25
Manganese monoxide (MnO)-----	8.26	9.26
Silica (SiO_2)-----	12.80	14.38
Insoluble not silica-----	1.25	1.40
Soluble iron oxide (Fe_2O_3)-----	1.21	1.36
Soluble aluminum oxide (Al_2O_3)-----	0.83	0.93
Sulfuric anhydride (SO_3)-----	0.26	0.29
Phosphoric oxide (P_2O_5)—less than-----	.01	.01
Water (H_2O)-----	10.94	-----
Manganese (Mn)-----	46.19	51.80
Available oxygen (O)-----	11.38	12.78
Iron (Fe)-----	0.85	0.95



Photo No. 19. Outcrop of manganese ore on Sec. 3, T. 5 S., R. 5 E., M. D. M., Stanislaus County. The manganese is below the large chert outcrops. Sperry-Wright lease; K. D. Winship, owner. Locally referred to as the Buckeye, or Wright Mine.

"The insoluble material not silica contains about 0.20% of Barium sulfate; also some alumina and calcium oxide and undoubtedly the soluble portion contains some calcium and magnesium oxides. The exact amount of these were not determined as they have no particular bearing on the use of the ore."

With the exception of the silica contained (which, apparently, came mainly from the lower grade pieces included in the sample) the ore is of excellent grade. The available oxygen is high, so that the material would be suitable for electric battery and glass purposes. Under the Wright Lease the lower "vein" has been opened up and to December 1, 1917, over 300 tons of ore shipped, which has averaged 48% Mn, and under 10% SiO₂. He expects to ship a car a week, as soon as he can improve transportation facilities. He has about 6 to 10 men at work and has opened up a face of ore from 5'-10' wide. No work has, as yet, been done on the upper ore zone.¹ The ore is hauled by motor trucks to the Southern Pacific Railroad at Vernalis.

In 1916 the Pacific Coast Manganese Company (Sartorius et al.) operated for a time on Sec. 18, T. 5 S., R. 6 E., on the south branch of Ingram Creek. They also had a lease on the Winship, Sec. 17 and 19, and a few carloads of ore were shipped. In 1917 these sections were leased to James J. Cummings, Livermore, who shipped a few carloads of manganese ore. He states that the ore was, so far as developed, irregular and not well defined. The hauling was done with teams to the railroad at Westley.

On Secs. 11 and 13, T. 5 S., R. 5 E., Donohue & McFarland have a lease on manganese prospects which they are developing; and on Sec. 25, Thompson Bros. of Ingomar are opening up manganese ore under lease. Both these sections are in the upper part of the Hospital Creek cañon.

Wright Lease. See **Winship Properties.**

TEHAMA COUNTY.

Elva Manganese Mine is in Section 20, T. 23 N., R. 7 W., 10 miles west of Paskenta, and 30 miles southwest of Corning, the nearest railroad station. It lies on the south slope of Beauty View Peak at an elevation of 2700 feet. Manganese oxides occur in lenses along a quartzose dike in a belt of serpentine. The croppings are extensive, but appear to contain a high percentage of silica. No ore has been produced and the claim is worked for assessment only. C. S. Beuner of Paskenta, is the owner.

*Analysis by Sidney A. Tibbetts, Berkeley, Cal.

¹Since the above was written, the main operations have been transferred to the 'upper zone,' where an orebody over 20' wide has been developed for a length of over 100'. Several hundred tons of excellent ore have been shipped. More recently, (August, 1918), the Sperry and Wright interests in the lease have been taken over by the Suffern Company, of #135 Broadway, New York.

Lockwood Prospect, Lett Lockwood of Newville, owner. This claim is located in Sec. 9, T. 23 N., R. 7 W., about one mile north of Toms Creek and Success Claim described below. The prospect lies on top of a butte of chert, having an elevation of 2650 feet (aneroid). The occurrence is similar to that described farther on (See Manganese Peak Claim) under Manganese Peak Group. The summit of the hill is covered by broken rock and soil charged by the manganese from the outcrop. The oxide pocket has a width of about 4 feet, but is covered along the strike by debris. No work has been done, but some development would seem warranted, as the outcrop is as promising in quality, though somewhat smaller, than on Manganese Peak.

Manganese Peak Group is owned by Lee Tatham and Alonzo Luce of Willows, Ancil Burrows of Newville, and E. P. Logan of Paskenta. The five claims lie in Secs. 17 and 20, T. 23 N., R. 7 W., between Bowers Creek and Toms Creek, just inside of California National Forest. The property is best reached from Logan Brothers' ranch, which is 10 miles from Paskenta, a stage station 24 miles from Corning. The claims are in the Franciscan area just west of the contact with Cretaceous rocks. The manganese oxides occur interbedded with the chert, which occurs as a lens surrounded principally by serpentine. The massive chert forms prominent conical buttes rising considerably above the general surface.

'Manganese Claim' is on the southwest slope of Beauty View Butte, at an elevation of 2650 feet (aneroid) two miles by trail from Logan Brothers Ranch. A small cut in shaly chert revealed siliceous manganese oxides too low grade to be termed ore. This prospect does not seem to offer much promise.

'Manganese Peak Prospect' lies on top of Beauty View Butte at an elevation of 2950 feet (aneroid). Float of manganese oxides can be traced down the south and east slopes. On the east side of outcrop on the very summit, six feet of siliceous oxides lie in chert walls, dipping nearly vertically and striking N. 40° W., in accordance with the enclosing chert. Separated from this on the west by about 15 feet of barren chert, is a somewhat wider band of similar quality. This oxide outcrops for a distance of about 20 feet along the strike. No work has been done here, but the indications are promising for the development of ore. The best of the material is probably of shipping grade, and an unknown portion of it has already been scattered by erosion.

The third prospect is $\frac{3}{4}$ mile northwest of the second, on the south side of the cañon of Toms Creek at an elevation of 1900 feet (aneroid), near Dead Rabbit Spring. A bold outcrop of shaly chert carries manganese chiefly as stains. A small cut here revealed no promising grade of material.

The fourth prospect is one mile northwest of Manganese Peak on the south bank of Toms Creek in the NW. $\frac{1}{4}$ of Sec. 17, at an elevation of 1650' aneroid. Badly broken rhythmically-bedded chert strikes N. 40° W., and dips 40° NE. A trench cut at right angles to the strike shows that the finely fractured chert is stained by a thin film of manganese oxide, but close examination failed to reveal any ore.

The fifth prospect is on Success Claim, in the SW. $\frac{1}{4}$ of Sec. 17, T. 23 N., R. 7 W., at an elevation of 2050 feet. There are three small outcrops in a width of 40 feet. The west outcrop shows $2\frac{1}{2}$ feet of massive chert carrying hard oxides of manganese. Ten feet east is a seam of soft oxides of good grade, a few inches wide. On the hanging wall (east) side of this seam, a bed of chert carries very siliceous oxides. Thirty feet east is a similar outcrop. This is the most promising prospect of the group.

Of the five prospects, the second and last appear to merit development, but the others are not promising. Some trail would have to be built in each case, totalling about one mile for both. The haul to Corning would be 36 miles.

TRINITY COUNTY.

Manganese occurs in Trinity County in the region about the headwaters of the South Fork and the Hayfork of Trinity River. It is found as the mixed oxides with traces of rhodochrosite and is interbedded with silica in the chert. Several claims have been located recently on these manganese outcrops but no production has been made yet. Following are the most promising claims:

The Caudwell Manganese Prospect is in the N. $\frac{1}{2}$ of Sec. 21, T. 28 N., R. 11 W., on a mountain side at an elevation of 4000 feet. It lies one mile due north of the mouth of Prospect Creek, a tributary of the East Fork of South Fork; about 71 miles from the railroad at Redding via Wildwood Inn, 14 miles being over trail. The claim is owned by Thomas Caudwell, care of Greenberg's Sons Co., 225 Beale St., San Francisco.

There are six parallel lenses of manganese oxide, interbedded with and grading into silica, over a total width of sixty feet. The maximum width noted of a lens was six feet. The alternating lenses of oxides and silica outcrop on the surface for about 300 feet along the strike; these have been further proven for an additional 150 feet by a 10 foot shaft. Assays of samples of the outcrop by A. A. Hanks are reported by the owner to have shown 42% to 64% manganese oxide. Assays of samples taken by an engineer of the Noble Electric Steel Co. are quoted to have run 38% to 58% oxide. The lenses strike north and dip nearly vertically. This prospect is the farthest south of several visited in that

region, and makes the most promising showing. The other prospects lie approximately in a north line from this one.

If development work shows sufficient tonnage on this and the other claims near it, and systematic assays substantiate the quality of ore, it is believed that a road could be built to connect with the highway at Wildwood for a reasonable sum if the tops of the ridges were followed. The owner has in mind the formation of a company to provide for road building. To make a success of shipping from here it would be necessary to handle a high grade ore only.

The Johnson manganese prospect, Wm. Johnson owner, is leased by the Noble Electric Steel Co. of Heroult, Shasta County. It is located near the south corner common to Secs. 9 and 10, T. 28 N., R. 11 W., about one and one-half miles nearly due north of the Caudwell prospect, at an elevation of 4200 feet and a short distance from the South Fork trail.

The small amount of work done showed a lens of mixed oxides of promising quality. It was two feet wide and uncovered over a total distance of 150 feet. The claim was located by Johnson in 1916 and was leased by the Noble Electric Steel Co. upon payment of a substantial advance royalty. Prospecting with a small crew was planned in September, 1917. Favorable developments on both this and the Caudwell claim are apt to lead to production next season, but from the showing made on this claim in August, it is not likely that its exploitation alone would be warranted, considering the distance from the highway. One road would serve all the prospects in the vicinity.

The Naphis Peak Mine is three miles north-northeast of Kekawaka Siding on the Northwestern Pacific Railroad. A sled road has been built to connect the mine with the railroad and a small production had already been made when the property was visited.

The Red Cliff Prospect is the property of W. J. Azbill of Covelo. It lies in Sec. 36, T. 25 N., R. 13 W., not far north of the Mendocino-Trinity counties line. When the region was last visited this claim was undeveloped.

The Selvester and Wilson prospect, located in 1916 by Joseph Selvester and James Wilson of Beegum, California, is on the South Fork Trail in SE. $\frac{1}{4}$ of Sec. 34, T. 29 N., R. 11 W., near the top of the divide at an elevation of 5000 feet. There is a small outcrop of mixed manganese oxides apparently of good grade, two feet wide. No work whatever had been done on this when visited. It is similar to the Johnson prospect and lies nearly north from it.

Besides these prospects there are others showing manganese, in the region. One on the Hayfork, about three miles north of the last named claim, was investigated by the Noble Electric Steel Co. but found

to be too siliceous for their use. C. R. Moser of Hayfork, Trinity County, reports finding a deposit of considerable size, of unknown manganese content in the same region.

J. F. McKnight and **G. W. Kindred** of Alderpoint, Humboldt County, located a deposit of manganese three and one-half miles northeast of Jewett siding on the Northwestern Pacific Railroad, just over the line from Humboldt County, in T. 4 S., R. 6 E. About thirty tons of ore which is reported runs only 27% metallic manganese was sledded down to the railroad, but has not been shipped out. The jasper beds with which the ore is associated, outcrop for about one and one-fourth miles, but there has been very little development work done upon them. Under lease to R. H. Austin, 1002 Clay St., Oakland, who is sampling the deposit.

TULARE COUNTY.

The Barbour Manganese Deposit is situated one mile west of Milo, in Sec. 33, T. 19 S., R. 29 E., about eight miles north of Springville, the terminus of the Porterville and Northeastern Railroad. A deposit of pyrolusite 18 inches wide occurs with a quartz vein in granitic rock. A 10 foot prospect shaft has been sunk on the vein, exposing about six tons of mixed ore. The property is idle and owned by Frank Barbour of Stockton.

The Cole Property is located 2 miles northeast of Lindsay in Sec. 32, T. 19 S., R. 27 E., M. D. M., at an elevation of 680'.

A siliceous ledge of manganiferous iron ore outcrops 25 feet wide and 100' long, striking N. 20° W. and dipping 75° SW., between walls of jasper and slate. Picked specimens of the mineralized ledge in places assay 35% metallic manganese, but an average is reported to be about 18%.

Development consists of a 30' shaft and an open cut along the ledge 10' wide and 30' long, exposing about 500 tons of mixed ore.

The property is idle and owned by R. D. Cole of Lindsay.

TUOLUMNE COUNTY.

The Madrid Property lies two miles north of Sonora, near Brown's Flat. Manganese oxide and rhodonite (manganese silicate) occur in a quartz vein along the contact of porphyry and schist. The mineralized portion varies up to 12' in thickness. The manganese is probably only superficial, and has not been worked. Owned by John Madrid of Jamestown, Tuolumne County.

The Sutton Manganese Property is located on Hog Mountain, four miles northeast of Jacksonville. There is reported to be a deposit of low grade ore which is 40' wide, 40' thick and 1600' long. The ore is reported to assay about 23% metallic manganese. Some development work has been done. Owned by Mr. Sutton of Jacksonville.

SYNOPSIS OF MANGANESE PROPERTIES IN CALIFORNIA.

Name of property	Owner or operator	Post-office address of owner or operator	Location of property (county)	Section, township and range	Length of haul, railroad shipping point	Tons shipped to date	Tons available, not shipped	Active or idle	Development and prospects for production
Jno. Berandiere	Jno. Berandiere	Livermore	Alameda	14-4-3	12 mi. Livermore			Idle	50' tunnel; no ore.
Black Jack	H. T. Overacker	Livermore	Alameda	14-4-3	12 mi. Livermore	1		Idle	35' tunnel; fair prospect.
Buckhorn	C. J. Janson	Livermore	Alameda	31-4-4	16 mi. Livermore			Idle	Promising prospect.
Camp No. 9									(See Merchant Mine and Crocker Properties.)
Crocker Properties	J. J. Cummings*	Livermore	Alameda	9-4-3	9 mi. Livermore	11		Active	Drifts and stopes.
Crosby	Wm. Crosby Estate	Livermore	Alameda	30-4-3	12 1/2 mi. Livermore		(40)	Idle	Undeveloped; promising.
Dewhirst	McDonald & Clark*	Livermore	Alameda	22-4-3	12 mi. Livermore		(30)	Active	Producing.
Donavan Lease	J. P. Donovan	Livermore	Alameda	31-3-4				Active	6' ore opened Dec., 1917.
Ellis Ranch	Edw. T. Ellis	Livermore	Alameda	28-3-3	8 mi. Livermore		(10)	Idle	Two o. c. promising.
Frigger Prospect	R. Frigger	Livermore	Alameda	22-4-3	12 mi. Livermore			Idle	Apparently a slide.
Jumbo Prospect	R. Frigger	Livermore	Alameda	14-4-3	12 mi. Livermore			Idle	Evidently very siliceous.
Kelly Ranch	Jno. Berandiere	Livermore	Alameda	14-4-3	12 mi. Livermore			Active	Prospecting; siliceous.
Merchant	Holbrook & McGuire*	Livermore	Alameda	5-4-3	9 mi. Livermore	1		Active	Now Crocker Properties.
Man Ridge	C. F. Wentz*	Livermore	Alameda	10-4-3	10 mi. Livermore	2		Active	(See Scott & Winegar.)
Newhall Lease	McDonald & Clark	Livermore	Alameda	22-4-3	12 mi. Livermore	1		Active	Years ago produced 10 T. low grade.
Reay	W. R. Reay	San Francisco	Alameda	36-3-3	Carnegie			Idle	Undeveloped; promising.
Root	J. W. Root	Livermore	Alameda	7, 18-5-4				Active	Producing.
Scott & Winegar	C. Scott et al.	Livermore	Alameda	7-5-4	22 1/2 mi. Livermore	9		Active	Producing.
Winegar	H. V. Winegar	Livermore	Alameda		20 mi. Livermore			Idle	An old tunnel; float.
Wiship	K. D. Wiship	San Francisco	Alameda	Various	Near Tesla			Active	(See Donavan Lease.)
Crocker-Preston	J. W. Preston, Jr., and M. I. Crocker	San Francisco	Alameda						
Everett Prospect	L. Everett	Mokelumne Hill	Amador	35-7-12	12 mi. Martell		30	New	Developing.
Rubser & Hubbard	F. Rubser et al.	Chipperr Mills	Amador		14 mi. Martell	3		Idle	Undeveloped prospect.
Bear Canyon	E. W. Woolley	Chipperr Mills	Butte	35-20-7	30 mi. Martell	4		Active	Discontinued work.
Powell	E. V. Powell	Chipperr Mills	Butte	35-20-7	30 mi. Oroville			Idle	Tunnel; prospecting.
View Point	F. C. Binet	Chipperr Mills	Butte	35-20-7	30 mi. Oroville			Idle	Tunnel and o. c. siliceous.
Former Ranch	Fortner	San Andreas	Calaveras		12 mi. Valley Sg.			Idle	Siliceous prospect.
Manilla Property	Dave Manilla	Angels Camp	Calaveras	27-4-11	6 mi. Valley Spring			Idle	Undeveloped prospect.
Red Rock	U. S. Government	Contra Costa	Contra Costa		6 mi. Valley Spring			Idle	Low-grade outcrop, undev.
Avery	G. D. Avery	Porterville	Fresno		9 mi. Coalinga			Idle	Siliceous, narrow seams.
Woods	Jake Rice	Pine Flat	Fresno					Idle	Outcrop assays fair.
Black Diamond	A. W. Schorn et al.	Willows	Glenn	14, 23-18-7	30 mi. Fruto	1		Idle	Low grade prospect.
Rattlesnake	Noyes et al.	Mech. Inst., S. F.	Glenn	6-18-6	25 mi. Fruto	4		Active	Ore body pinched to stringer.
Porter Ranch	L. M. Bryant & Bros.*	Grizzly Bluff	Humboldt	32-3-4	Carlotta or Eureka			Active	Shaft shows 6' ore. Trenches show good ore.

MANGANESE AND CHROMIUM.

Property	Owner	San Francisco	Humboldt	3-1-4	17 mi. Fort Seward	Active	Notes
Woods Prospect	F. M. Doak et al.*	San Francisco	Imperial ²	3-1-4	17 mi. Fort Seward	Active	New, undeveloped.
Johnson	J. H. Lightfoot*	Blythe	Imperial ²		30 mi. Blythe	Active	Narrow shallow vein.
Connard Bros.	Johnson	Glamis	Imperial		30 mi. Glamis	Idle	Undeveloped narrow veins.
Death Valley	F. P. Underwood et al.	Barstow	Inyo		38 mi. Zabriskie	Idle	Undeveloped narrow veins.
Lovett & Sullivan Group	T. Lovett et al.	Randsburg	Kern		32 mi. Zabriskie	Idle	Undeveloped narrow veins.
Coleman Prospect	J. H. Coleman et al.	Cobb	Lake ³	29-12-9	32 mi. Calistoga	Idle	Undeveloped narrow veins.
Herman Prospect	A. Herman	Middletown	Lake		29 mi. Calistoga	Active	Undeveloped, siliceous.
Herrick Prospect	S. B. Herrick	Upper Lake	Lake	25-11-8	21 mi. Calistoga	Active	Exposes low grade.
Van Ranch	G. H. Van	Upper Lake	Lake	34-17-10	38 mi. Ukiah	Idle	Very promising prospect.
Amargosa	C. L. Metzger et al.	Los Angeles	Los Angeles	6-12	5 mi. Palmdale	Idle	High in silica.
Gladwin & Peet	G. L. Gladwin et al.	Los Angeles	Los Angeles	36-6-14	5 mi. Palmdale	Idle	Small low grade.
Mailiard Ranch	Lagunitas Dev. Co.	San Francisco	Marin		2 mi. Woodacre	Idle	Erratics in serpentine.
Sausalito Point	U. S. Government	Fort Baker	Marin		3 mi. Sausalito	Idle	Small high-grade streak.
Big Bend Claims	C. V. Breton et al.	Fort Baker	Mendocino ⁴	28-23-11	8 mi. from a road	Active	18" good ore reported.
Bland's Cove	D. D. McLaughlin	Potter Valley	Mendocino			Active	9 undeveloped claims.
Busch & Bevins	S. H. Busch et al.	Ukiah	Mendocino	3, 10-17-12	22 mi. Ukiah	Active	Promising showing.
Cleveland Property	R. L. Cleveland	Potter Valley	Mendocino	13-16-12	3 mi. Calpella	Idle	Some good ore.
Foster Mountain	Geo. Busch	Potter Valley	Mendocino	3-18-12	14 mi. Willits	Idle	
Guthrie	A. Guthrie	Spyrook	Mendocino		7 mi. Spyrook	Active	Developed prospect.
Hopper Claim	G. E. Purrell et al.	Covelo	Mendocino	16-17-11	30 mi. Ukiah	Idle	Unpromising prospect.
Little Deer Claim	W. McClendon	Calpella	Mendocino	17-25-12	39 mi. Dos Rios	Idle	Undeveloped prospect.
McClendon Ranch	Chas. Breton	Covelo	Mendocino		5 mi. Calpella	Idle	Work suspended, 1917.
Michaels, Roman & Weeks	W. D. Frey et al.	Covelo	Mendocino	23-23-11	20 mi. Dos Rios	Idle	Under attachment, 1917.
Mt. Sambedrin Claim	C. V. Breton	Covelo	Mendocino	{ 6-10-11	{ 25 mi. Willits	Active	Good prospects; carbonate.
New Year Claim	W. D. Rhodes et al.	Covelo	Mendocino	{ 30-20-11	{ 19 mi. Dos Rios	Active	2' good ore.
Rhodes & Hurt	Noble Elect. S. Co.	San Francisco	Mendocino	36-23-12	18 mi. Dos Rios	Idle	New, undeveloped.
Shell Rock Deposit	W. E. Shields et al.	Covelo	Mendocino	{ 19-7-5	{ 6 mi. Spyrook	Idle	New, undeveloped.
Shields & Packwood	Lee Taylor	Redwood Valley, via Calpella	Mendocino	{ 18 mi. Dos Rios	{ 18 mi. Dos Rios	Idle	Samples assayed 7% Mn.
Thomas Mine	W. P. Thomas et al.	Ukiah	Mendocino	22-17-12	6 mi. Redwood	Active	Extensive bodies, good ore.
Wild Devil Mine	J. D. Waldteufel	Ukiah	Mendocino	16, 16-17-12	8 mi. Redwood	Idle	May develop more ore.
Briggs Mine	Mrs. A. Briggs	Hollister	Merced	13-13-9	26 mi. Tres Pinos	Active	Very promising.
Ross Ranch	J. Dutra Ross	Cambria	Monterey	32-24-6	1 mi. from ocean	Idle	Outcrop reported 40% Mn.
Dacon & Kenny	F. W. Kenny et al.	Oakville	Napa	19-7-5	5 mi. Oakville	Idle	Too small and low grade.

* Lessee.

¹For key to the figures shown in this column, which are intended to indicate approximately the production to January 1, 1918, see last page of table.

²1,700 tons shipped from Glamis, Imperial County, and 207 tons from another point, exact location not known.

³40 tons shipped from an unclaimed property in Lake County by Lew Thorne.

⁴A total of 148 tons was shipped by three small producers in 1917, in addition to those here listed, but they did not state location of their properties.

SYNOPSIS OF MANGANESE PROPERTIES IN CALIFORNIA—Continued.

Name of property	Owner or operator	Post-office address of owner or operator	Location of property (township)	Section, township and range	Length of haul, railroad shipping point	Tons shipped to date	Tons available, not shipped	Active or idle	Development and prospects for production
Cavagnaro	Chas. Cavagnaro	Middletown	Napa	3-9-6	18 mi. St. Helena	---	---	Active	High in Fe and Si.
Moore Creek			Napa	15-8-5	6 mi. St. Helena	---	---	Idle	Shows some good ore.
Wren Ranch	R. M. Wren	Wolf	Nevada	20-14-8	16 mi. Auburn	---	---	Active	Small body; high grade.
Bartholf & Veach	E. H. Bartholf et al.	Box 97, Colfax	Nevada	---	7 mi. Colfax	2	---	Active	Producing.
Tilsley & Coplen	C. S. Simpson	Colfax	Placer	20-14-10	9 mi. Colfax	1	---	Active	Producing; very promising.
Gray Claims	Lee Gray	Colfax	Placer	19-14-10	10 mi. Colfax	---	---	Idle	New claims on R. R. land.
Brinko Mine	F. E. Bratto et al.	Crecent Mills	Plumas	26-26-9	Near railroad	11	---	Active	Open cuts and tunnel; high grade.
Burch & Woody	Burch & Woody	Crecent Mills	Plumas	21-26-9	4 mi. Crecent Mills	---	---	Idle	Ore mined was too siliceous.
Crystal Lake	Kloppenburg et al.	Quincy	Plumas	8-25-10	5 mi. Indian Falls	6	---	Active	Now leased to Smith Bros.
Diadem Lode	Edman Estate	Quincy	Plumas	33-24-8	14 mi. Quincy	---	---	Idle	Occurs in quartz; thought superficial.
Iron Queen	Devlinn & Smith	Crecent Mills	Plumas	8-26-9	6 mi. Crecent Mills	---	---	---	Very little work; some good ore.
Penrose Mine	Edman Estate	Quincy	Plumas	13-4-10	12 mi. Quincy	---	---	Idle	In quartz gossan; considered superficial.
Black Jack	C. F. Bradford et al.	Blythe	Riverside	---	1 mi. C. S. Railway English	---	---	Idle	Said to have over 1,000 T. about 30%.
Bray	P. H. Bray	Blythe	Riverside	13-4-19	12 mi. Mineral	1	---	Active	Considered extension of Black Jack.
Prum & Newport	G. Brum, L. Newport	Perris	Riverside	---	7 mi. Perris	---	---	Active	Tunnel and shaft show narrow veins.
Black Horse Group	F. Brown et al.	Blythe	Riverside	4-19----	12 mi. Mineral	---	---	Idle	Narrow unprospected veins.
Doran Claims	W. O. Doran et al.	Los Angeles	Riverside	---	22 mi. Mineral	---	---	Idle	Undeveloped; inaccessible; good assays.
Elsinore Deposit	C. P. Carter	Elsinore	Riverside	22-5-4	6 mi. Elsinore	---	---	Idle	Undeveloped; vein 3'-4' wide.
Grosse Claims	C. E. Grosse	Blythe	Riverside	13-4-9	12 mi. Mineral	1	---	Active	2 shafts show vein widening.
Hauser, Martin & Chesborough	Hauser	1138 Oxford Av., Los Angeles	Riverside	---	2½ mi. Mineral	2	---	Idle	All ore in sight been mined.
Mabery & Brown	C. E. Brown et al.	Mecca	Riverside	---	2 mi. Mineral	1	---	Active	Now mining 4 tons daily.
Palo Verde	Lugo & Smith	Palo Verde	Riverside	---	16 mi. Blythe	---	---	Active	500 tons said to carry 35%.
Fries Ranch	Peter Fries	Hollister	San Benito	5, 8-13-8	18 mi. Tres Pinos	---	---	Idle	Promising; extension of Hendricks.
Hannagan Ranch	E. T. Stewart*	Dos Palos	San Benito	22-15-9	21 mi. Tres Pinos	---	---	Idle	Open cut gave 7 tons; float.

MANGANESE AND CHROMIUM.

Property	Agent	Locality	Production	Notes	Remarks	Other	Remarks
Hawkins Ranch	G. W. Grayson, Agent.	Hollister	35-11-6	13 ml. Hollister.	2	Active	Preparing to resume work.
Hendricks Mine	D. McPhail, Agent.	Hollister	24-13-8	23 mi. Tres Pinos.			Very promising; planning operation.
Lewis Ranch	Wm. Lewis	Tres Pinos	7-13-8	19 mi. Tres Pinos.		Idle	Adjoins Eries Ranch.
Black Prince	C. S. van Horn et al.	Daggett		35 mi. Riggs		Active	5' shaft; not promising.
Emma Claims	Ruben Stenton	Silver Lake		36 mi. Riggs		Active	20' tunnel shows 12" ore.
Levic Mountain	A. Seymour et al.	Silver Lake		5 mi. Ludlow		Active	Opens cuts; lot 30-33% ore.
Owl Hole	A. Yeoman	Silver Lake		35 mi. Riggs	13	Active	Shafts 6' deep; shows 4'-6' ore; in litigation.
Crocker Property	M. I. Crocker.	San Francisco	35-4-4			Idle	Undeveloped prospect.
Ladd Mine	Western Rock Prod. Co.	San Francisco	2-4-4	1 1/2 ml. Manganese	14,000 to 16,000	Active	Several thousand tons blocked out.
Winship Property	Jas. J. Cummings*	Oakland	11, 13-4-4	Joins Ladd Mine.	8	Active	{ Shaft, tunnel, stop; good outlook.
Evans Prospect	W. & J. Evans.	San Simeon	19-4-5	12-14 mi. San Simeon		Idle	2 undeveloped prospects.
Hearth Ranch	Phoebe Hearst	San Francisco	3-25-6	3 mi. San Simeon.		Idle	Newly located prospect.
Hobson Claims	W. K. Hobson	Cayucos		8 mi. Cayucos.		Idle	Slightly prospected; similar to Philan.
Jobe Ranch	Manganese Co. of Cal.*	180 Sutter, S. F.		10 mi. San Luis Obispo		Active	Flout 78% MnO ₂ ; 5 men prospecting.
Phelan Ranch	Phelan Bros.	Cambria		10 ml. San Simeon.		Idle	Reported high silica; strong outcrop.
Riceoli Prospect	V. Riceoli	Cayucos		26 ml. San Luis O.		Active	Prospect being opened; promising.
Staneuch Ranch	Manganese Co. of Cal.*	180 Sutter, S. F.		8 ml. San Luis O.	2	Active	Produces high-grade ore.
Welsh Ranch	Noble Elect. Steel Co.*	995 Market, S. F.		8 ml. San Luis O.		Active	Producing @ 2 cars week; high grade.
La Laguna Ranch	La Laguna Ranch Co.	Pasadena		10 ml. Los Olivos.		Active	Outcrops 45% Mn.; very small bodies.
Ala Mountain	Merchant Estate	Livermore	28-5-4	26 mi. Livermore.	1	Active	Veins up to 3' wide; some ore out.
Black Bear	D. P. Doak.	San Francisco	34-5-4	25 mi. Livermore.		Active	{ Surface work only; Jones tunnel shows 8' ore.
Black Bird	Mineral Products Co.	San Francisco	28-6-5	{ N.F. gasoline tram } { on Co.'s own line }	3	Active	5' hole shows siliceous oxide.
Black Wonder	Mineral Products Co.	San Francisco	27-6-5	2 1/2 ml. Livermore.		Idle	23' 5' siliceous ore, 300' on strike.
Davenport Prospect	K. D. Winship	San Francisco	27-5-4	25 mi. Livermore.		Idle	
Davenport & Smith	K. D. Winship	San Francisco	27-5-4			Idle	
Doak Mine No. 2	D. P. Doak.	San Francisco	22-5-4	25 mi. Livermore.	?	Idle	O. C.'s and tunnel showed 4' ore.
Fable Mine	Thos. Green	Dublin	54-5-4	26 mi. Livermore.	?	Idle	Produced in past; 6' ore 28% Mn. 30% SiO ₂ .

*Lessee.

For key to the figures shown in this column, which are intended to indicate approximately the production to January 1, 1918, see last page of table.

SYNOPSIS OF MANGANESE PROPERTIES IN CALIFORNIA—Concluded.

Name of property	Owner or operator	Post-office address of owner or operator	Location of property (county)	Section, township and range	Length of haul, railroad shipping point	Tons shipped to date	Tons available, not shipped	Active or	Development and prospects for production
Koller Prospect	Koller Bros.	San Francisco	Santa Clara	13-6-4	32 mi. Livermore	---	---	Active	New prospect; undeveloped.
Mammoth Prospect	H. H. Ballantine	San Francisco	Santa Clara	13-6-4	33 mi. Livermore	2	---	Active	3/4' siliceous ore.
Mineral Products Co.	Mineral Products Co.	San Jose	Santa Clara	28-6-5	Nr. Co.'s own R. R.	---	---	Idle	Large blocks of oxide ore.
Matros Ranch	J. D. Matros	Livermore	Santa Clara	8-6-2	8 mi. Milpitas	1	---	Idle	Tunnel & cut gave ore, 1916.
Newhall Mine	E. P. Newhall	San Jose	Santa Clara	36-5-4	35 mi. Livermore	---	---	Active	3' ore; carbonate and oxide.
Pennsylvania Mine	M. M. Day	San Jose	Santa Clara	12-7-4	35 mi. Livermore	3	---	Idle	100 T. siliceous ore; little work
Winship Property	Holbrook et al.	San Jose	Santa Clara	27-5-4	30 mi. Livermore	2	---	Idle	Extensive; undeveloped.
Wallace Ranch	Mrs. G. P. Wallace	Redding	Santa Clara	8-6-2	63 mi. Milpitas	---	---	Idle	Undeveloped; assays high.
Pit River Consolidated	Shasta Copper Co.	Yreka	Shasta	36-34-4	1 mi. Heroult	---	---	Idle	Siliceous, not well defined.
Barham Prospect	W. W. Barham	Happy Camp	Siskiyou	9-44-8	11 mi. Yreka	---	---	Idle	New location; siliceous.
Davis Prospect	Reeves Davis	Los Angeles	Siskiyou	---	78 mi. Yreka	---	---	Idle	7' wide; high in Fe.
Dozier Prospect	Dozier	Sawyers Bar	Siskiyou	15-46-6	6 mi. Klamathon	---	---	Idle	30% SiO ₂ , 37% Mn.
Skillen & Means	G. G. Skillen	Cloverdale	Siskiyou	---	53 mi. Yreka	---	---	Idle	Extensive, undev., remote.
Hunter Mine	Wm. Hunter	Calistoga	Sonoma	---	22 mi. Healdsburg	2	---	Idle	Mined in summer, 1917.
McLean & Clark	W. J. McLean	Geyserville	Sonoma	---	9 mi. Geyserville	---	---	Idle	Undeveloped prospect.
Shanks Lease	S. R. Boyer	Cloverdale	Sonoma	31-42-11	7 mi. Cloverdale	1	---	Active	6' ore in tunnel; 42-50% Mn.
Shaw & Mathews	G. C. Mathews	Cloverdale	Sonoma	---	9 mi. Geyserville	---	---	Active	Ore in slight siliceous.
Wheeler Prospect	M. I. Crocker	San Francisco	Stanislaus	33-5-6	---	---	---	Active	Extension Shanks Lease.
Crocker Prospect	W. M. Grummit	Westley	Stanislaus	6-5-6	Vernalis	1	---	Active	Undeveloped outcrop.
Grunnet Ranch	Dave Mitchell	Westley	Stanislaus	---	---	5	---	Active	18' to 2' ore.
Mitchell Mine	W. M. Grummit	Westley	Stanislaus	6-5-6	---	---	---	Active	Shallow cuts.
Phillips Lease	W. M. Grummit	San Francisco	Stanislaus	9 etc. 6-5	Nr. Santa Clara Co.	---	---	Active	See Black Wonder.
Mineral Products	Mineral Products Co.	Tracy	Stanislaus	3-5-5	14 mi. Vernalis	3	---	Active	5'-10' wide; average 48% Mn.
Winship Property	M. A. Wright	Livermore	Stanislaus	17, 19-5-6	Westley	---	---	Active	Irregular bodies.
Winship Prospect	J. J. Cummings	Paskenta	Stanislaus	20-23-7	34 mi. Corning	1	---	Idle	Undeveloped, siliceous.
Elva Prospect	C. S. Beuner	Paskenta	Tehama	17, 20-23-7	34 mi. Corning	---	---	Idle	2 claims promise ore.
Manganese Peak	E. P. Logan et al.	225 Beale, S. F.	Trinity	21-25-11	71 mi. Redding	---	---	Idle	6 lenses, proven for 450'.
Caudwell Property	Thos. Caudwell	San Francisco	Trinity	10-25-11	69 mi. Redding	---	---	Active	2' wide outcrops 150'.
Johnson Property	Noble Elect. Steel Co.*	Alderpoint	Trinity	36-25-13	3 mi. Kekawaka	1	---	Active	Producing small tonnage.
Naphis Peak	Frank Ashill	Covelo	Trinity	34-29-11	83 mi. Redding	---	---	Idle	Undeveloped prospect.
Red Cliff Prospect	W. J. Ashill	Beegum	Trinity	---	---	---	---	Idle	1 small outcrop, undev.
Selvester & Wilson	Jos. Selvester et al.	Beegum	Trinity	---	---	---	---	Idle	---

McKnight & Kindred.....	J. F. McKnight et al.....	Alderpoint	Trinity	--- 4-6 3½ mi. Jewett.....	-----	Idle	Ore mined said to carry 27% Mn. Narrow lens in granite. Said to average 18% Mn. ----- Considered superheated. Reported large amount 23% Mn.
Barbour Prospect	F. Barbour	Stockton	Tulare	33-19-29	8 mi. Springville.....	Idle	
Cole Property	R. D. Cole.....	Lindsay	Tulare	32-19-27	2 mi. Lindsay.....	Idle	
Hughes Ranch	B. A. Ogden.....	Knights Ferry	Tuolumne		2 mi. Sonora.....	Idle	
Madrid Property	John Madrid	Jamestown	Tuolumne		9 mi Chinese.....	Idle	
Sutton Property	Sutton	Jacksonville	Tuolumne				

*Lessee.

1 indicates production under 100 tons
2 indicates production between 100 and 200 tons.
3 indicates production between 200 and 300 tons.
4 indicates production between 300 and 400 tons.
5 indicates production between 400 and 500 tons.

6 indicates production between 500 and 600 tons.
7 indicates production between 600 and 700 tons.
8 indicates production between 700 and 800 tons.
9 indicates production between 800 and 1,000 tons.
11 indicates production between 1,000 and 1,500 tons..

12 indicates production between 1,500 and 2,000 tons.
13 indicates production between 2,000 and 3,000 tons.
14 indicates production between 3,000 and 4,000 tons.
15 indicates production between 4,000 and 5,000 tons.

PURCHASERS OF MANGANESE AND MANGANIFEROUS ORES.¹

- a Purchase manganese ore with 40 per cent or more manganese and less than 2 per cent iron.
- b Purchase manganese ore with 40 per cent or more manganese and 2 per cent or more iron.
- c Purchase manganiferous ore with 15 to 40 per cent manganese.

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- c Alan Wood Iron & Steel Co., Philadelphia, Pa.
 - c Algoma Steel Corp., Sault Ste. Marie, Ontario, Canada.
 - c Alleghany Ore & Iron Co., Buena Vista and Iron Gate, Va.
 - a American Carbon & Battery Co., East St. Louis, Ill.
 - a American Ever Ready Battery Co., Long Island City, N. Y.
 - bc American Manganese Mfg. Co., Bullitt Bldg., Philadelphia, Pa. (or Dunbar, Pa.)
 - bc American Steel Foundries, McCormick Bldg., Chicago, Ill.
 - a Anglo-American Flash Light Co., Pittsburgh, Pa.
 - c James B. Bailey, Pine Forge, Pa.
 - b Beckman & Linden Engineering Corp., Bay Point, Cal.
 - ab Bennett-Brooks, 120 Liberty St., New York, N. Y.
 - ab Berkshire Iron Wks., Bullitt Bldg., Philadelphia, Pa.
 - bc Bethlehem Steel Corp., South Bethlehem, Pa.
 - ab Bilwore Alloys Co., 201 Bernice Bldg., Tacoma, Wash.
 - ab Binney & Smith, 81 Fulton St., New York, N. Y.
 - ab Chas. A. Burdick, E. M., 15 Broad St., New York, N. Y.
 - abc C. F. Burgess Laboratories, Madison, Wis.
 - a L. H. Butcher & Co., Marine Bldg., San Francisco.
 - abc Cambria Steel Co., Pittsburgh, Pa.
 - ab Carnegie Steel Co., Pittsburgh, Pa.
 - bc Central Iron & Coal Co., Holt, Ala.
 - bc Charcoal Iron Co., Detroit, Mich.
 - a Charles B. Crystal, New York, N. Y.
 - c Cleveland-Cliffs Iron Co., Cleveland, Ohio.
 - c Colorado Fuel & Iron Co., Pueblo, Colo.
 - ab W. R. Cuthbert (National Paint & Manganese Corp.), Lynchburg, Va.
 - bc Delaware River Steel Co., Chester, Pa.
 - abc W. H. Denison, Cushman, Ark.
 - b Electric Reduction Co., Washington, Pa.
 - b Empire Steel & Iron Co., Catsauqua, Pa.
 - b Fuller & Warren Co., Troy, N. Y.
 - ab Robert Gilchrist, 82 Beaver St., New York City.
 - b Goldschmidt Thermit Co., New York, N. Y.
 - a Charles Hardy, 50 Church St., New York, N. Y.
 - a Harshaw, Fuller & Goodwin Co., Electric Bldg., Cleveland, Ohio.
 - a Hazel-Atlas Glass Co., Clarksburg, W. Va.
 - c W. P. Heath & Co., 509 Olive St., St. Louis, Mo.
 - bc Hickman, Williams & Co., St. Louis, Mo.
 - ab C. W. Hill Chemical Co., Los Angeles, Cal.
 - ab E. C. Humphrey & Co., Detroit, Mich.
 - a Illinois Pacific Glass Co., San Francisco.
 - ab Illinois Steel Co., 208 South La Salle St., Chicago, Ill.
 - a Import Chemical Co., New York, N. Y.
 - bc Jones & Laughlin Steel Co., Pittsburgh, Pa.
 - b Juniata Furnace & Foundry Co., 30 West Girard Ave., Philadelphia, Pa.

¹Reprinted from a list furnished by the United States Geological Survey, which appeared in our Prelim. Rept. No. 3.

- c La Belle Iron Works, Steubenville, Ohio.
 c La Follette Coal & Iron Co., La Follette, Tenn.
 bc Lackawanna Steel Co., Buffalo, N. Y.
 a J. S. Lamson & Bros., Inc., 80 Maiden Lane, New York, N. Y.
 ab E. J. Lavino & Co., Bullitt Bldg., Philadelphia, Pa.
 a C. W. Leavitt & Co., 30 Church St., New York, N. Y.
 b Lebanon Blast Furnace Co., Lebanon, Pa.
 a Levensaler-Speir Corp., Monadnock Bldg., San Francisco, Cal.
 ab David Loeser, 1400 Broadway, New York, N. Y.
 ab Los Angeles Pressed Brick Co., Los Angeles, Cal.
 bc Low Moor Iron Co. of Va., Lowmoor, Va.
 b T. L. McCarty, Box 217, Eureka, Utah.
 c McKeefrey Iron Co., Leetonia, Ohio.
 a Manhattan Electrician Supply Co., 41-47 Morris St., Jersey City, N. J.
 abc E. E. Marshall, Bullitt Bldg., Philadelphia, Pa.
 ab The Metalores Corp., 56 Pine St., New York, N. Y.
 abc Miami Metals Co., Tower Bldg., Chicago, Ill.
 ab Mines & Metals Corp., 77 Broad St., New York, N. Y.
 c Mississippi Valley Iron Co., 6500 South Broadway, St. Louis, Mo.
 bc National Alloy Co., Philadelphia, Pa.
 a National Carbon Co., Cleveland, Ohio.
 abc Noble Electric Steel Co., 995 Market St., San Francisco, Cal.
 c Northwestern Iron Co., Milwaukee, Wis.
 a Nungesser Carbon & Battery Co., Cleveland, Ohio.
 ab Oakley Paint Mfg. Co., Los Angeles, Cal.
 c Old Dominion Pig Iron Corp., Roanoke, Va.
 b Pacific Coast Steel Co., San Francisco, Cal.
 abc Pacific Electro Metals Co., Balboa Bldg., San Francisco, Cal.
 ab Pacific Sewer Pipe Co., Los Angeles, Cal.
 c Perry Iron Co., Erie, Pa.
 a Pittsburgh Lamp Brass & Glass Co., Pittsburgh, Pa.
 c Pittsburgh Steel Co., Pittsburgh, Pa.
 c Pulaski Iron Co., Pulaski, Va.
 e Republic Iron & Steel Co., Birmingham, Ala.
 ab A. P. Rice, Spencer, Ohio.
 b Ricketson Mineral Paint Wks., Milwaukee, Wis.
 ab Rogers, Brown & Co., New York, N. Y.
 bc Frank Samuel, Philadelphia, Pa.
 c John A. Savage & Co., Duluth, Minn.
 c Scullin Steel Co., St. Louis, Mo.
 abc Seaboard Steel & Manganese Corp., 50 East 42d St., New York, N. Y.
 c Seattle Smelting Co., Van Asselt Station, Seattle, Wash.
 ab Arthur Seligman, 165 Broadway, New York, N. Y.
 bc Shaffer Engineering Co., Nazareth, Pa.
 bc Sligo Furnace Co., 915 Olive St., St. Louis, Mo.
 e Sloss-Sheffield Steel & Iron Co., Birmingham, Ala.
 f C. Soloman, Jr., South San Francisco, Cal.
 abc Southern Manganese Corp., Anniston, Ala.
 bc Standard Steel Works Co., 11th Floor, Morris Bldg., Philadelphia, Pa.
 ab Oscar Stromberg, Tribune Bldg., New York, N. Y.
 abc The Suffern Co., Inc., 96 Wall St., New York, N. Y.
 ab Superior Portland Cement Co., Concrete, Wash.
 c Tacoma Metals Co., Tacoma, Wash.
 abc Tennessee Coal, Iron & Railroad Co., Birmingham, Ala.
 c Thomas Iron Co., Hokendauqua, Pa.
 c Toledo Furnace Co., Toledo, Ohio.

- a U. S. Glass Co., Pittsburgh, Pa.
 bc United States Steel Corp., Empire Bldg., New York, N. Y.
 b Utah Iron & Steel Co., Salt Lake City, Utah.
 b Vanadium Steel Alloys Co., Latrobe, Pa.
 ab Western Reduction Co., Portland, Ore.
 b Wharton Steel Co., Morris Bldg., Philadelphia, Pa.
 c Wickwire Steel Co., Buffalo, N. Y.
 c Wisconsin Steel Co., Harvester Bldg., Chicago, Ill.
 c Worth Bros. Co., Widener Bldg., Philadelphia, Pa.

PRODUCTION OF MANGANESE ORE IN CALIFORNIA.

Production of manganese ore in California began at the Ladd Mine, San Joaquin County, in the Tesla District in 1867. When shipments of this ore to England ceased late in 1874, upwards of 5000 tons had been produced by that property. For some years following that, the output was small. The tabulation herewith shows the California output of manganese ore, annually, since 1887, when the compilation of such figures was begun by the State Mining Bureau:

Year	Tons	Value	Year	Tons	Value
1887 -----	1,000	\$9,000	1904 -----	60	\$900
1888 -----	1,500	13,500	1905 -----		
1889 -----	53	901	1906 -----	1	30
1890 -----	386	3,176	1907 -----	1	25
1891 -----	705	3,830	1908 -----	321	5,785
1892 -----	300	3,000	1909 -----	3	75
1893 -----	270	4,050	1910 -----	265	4,235
1894 -----	523	5,512	1911 -----	2	40
1895 -----	880	8,200	1912 -----	22	400
1896 -----	518	3,415	1913 -----		
1897 -----	504	4,080	1914 -----	150	1,500
1898 -----	440	2,102	1915 -----	4,013	49,098
1899 -----	295	3,165	1916 -----	13,404	274,601
1900 -----	131	1,310	1917 -----	15,515	396,659
1901 -----	425	4,405			
1902 -----	870	7,140	Totals -----	42,558	\$810,159
1903 -----	1	25			

PART II.

CHROMIUM.

INTRODUCTION.

By C. A. LOGAN.

History.

Chromium was discovered about 1797 by a French chemist, Louis Nicolaus Vauquelin, in ore from Siberia.¹ From that time until 1827 the Urals, in the region of Ekaterinburg, supplied the chromium used in Europe. In the summer of 1827, as the historian advises us, Isaac Tyson, Jr., saw in a Baltimore market-place a cart containing a cider barrel, which was held from rolling about by some heavy black stones. He had made a study of such stones at the first known American locality, the Bare Hills near his father's home, six miles from Baltimore, and he recognized the black stones as chromite. On inquiry, he found the chromite came from the Reed Farm in Harford County, 27 miles northeast of Baltimore. At this time, Tyson was one of the very few men in the country who knew the value of chromite, and in the next few years he took full advantage of this knowledge.

He immediately bought the Reed Farm. He found about 30 tons of float ore on the surface, but there was no outcrop of ore in place. Nevertheless he sank a shaft, and at a depth of eight feet struck an ore-pocket which proved to be 80' long, 25' wide, and 8' in maximum thickness. His next discovery was of placer chromite in the sands in the beds of brooks on an estate called Soldiers' Delight, 16 miles northwest of Baltimore. Thus far, Tyson's observations had shown him that chromite occurred apparently only in serpentine areas. His explorations were now leading him farther afield. In 1828 he found on the Wood Farm, in Lancaster County, Pennsylvania, a deposit of float chromite which led him to lease the ore right of the farm, which he finally purchased in 1832. Here he developed the famous Wood Mine, the largest single producer of chromite in the world. This property has yielded about 100,000 tons of ore. Exploring the southern Appalachian region in this way, Tyson shortly obtained control of mineral rights in an area about 60 miles long, extending northward from Soldiers' Delight and including all the paying chromite properties in Maryland, Pennsylvania and Virginia.

The monopoly thus established was enjoyed by the Tysons from 1827 to 1860, during which time the Baltimore region produced practically

¹Glenn, William, Chrome in the southern Appalachian region: Trans. A. I. M. E., vol. 25, p. 482, 1895.

all the world's supply of chromite. The discovery of chromite near Brusa in Asia Minor in 1848 by an American geologist, J. Lawrence Smith, led to the opening of several districts which shipped their ores from Macri and Ghemlek, and finally took the monopoly away from America.

Genesis of Chromite Deposits.

It is well settled that chromite deposits are the result of magmatic segregation, and this point has been brought out in a rather copious literature, from which only a few salient points can be quoted here. The theory, in brief, is that minerals separate from molten magma in the inverse order of their solubilities in the fused mass. The more basic, among which chromite is prominent, are the least soluble and separate first, while other minerals remain in a fused state. Fully developed crystals of chromite occur, imposing their outlines on the surrounding mass of other minerals, which are thus proven to have crystallized later than the chromite. While chromite is not an essential mineral¹ in peridotite and allied rocks, its almost constant occurrence in them is emphasized by numerous writers.

The theories dealing with the mechanics of cooling magmas are that the crystallization would first take place on the outer boundaries of the molten mass, which in the case of an intrusive like peridotite or dunite, would be injected into the country rock as a plug, chimney or sill. Convection currents would tend to bring new supplies to the outer boundaries. Chromite, crystallizing first or nearly first of the minerals in the magma, would tend to collect near the outer boundaries of the intrusive. In line with this reasoning, J. H. Pratt² points out that the chromite which occurs as imbedded masses and disseminated particles in all North Carolina peridotite, is seen to be near the borders of the peridotite lenses. Reference to many of our California chromite deposits bears out this theory fully.³ The point is one that ought to be taken account of by the chrome prospector, who wishes to know where his search is most apt to be rewarded.

OCCURRENCES IN CALIFORNIA.

Chromite has been found in quantity sufficient to mine in twenty-four counties of California. The records of this Bureau indicate that shipments were made from all these counties but two during 1916 or 1917, and both these counties have recently reported production. Outside of certain placer gravels, all the chromite mined here so far, except

¹J. V. Lewis—Geol. Survey of North Carolina. Bull. 11. See also the publications of Geol. Surveys of Maryland, Pennsylvania and Georgia.

²Pratt, J. H., The occurrence, origin, and chemical occurrence of chromite: Trans. A. I. M. E., vol. 29, pp. 17-39, 1899.

³See also "Chromite," A. Burch and S. H. Dolbear, pages 19-20. Their theory is that folding, faulting and erosion expose the bodies of chromite.

one body in Plumas County, has occurred in serpentine or in rocks which yield serpentine on weathering. The single exception is said to occur in limestone and has yielded about 200 tons. The serpentine areas of California are generally considered to be of various ages; the areas associated with the Franciscan series of the Coast Ranges have been called upper Jurassic, and those in the Klamath region have been considered by some geologists as pre-Cambrian, while the serpentine along the Mother Lode is thought to be of similar age to that in the Coast Ranges. Good producers have been developed in all the three regions, but each district shows interesting features.

Southern Coast Range Counties.

The principal chromite mines of San Luis Obispo County are grouped in a small area lying six to nine miles north of San Luis Obispo, and ore is shipped from there and from Goldtree. Roads are generally good and largely in favor of traffic, as the mines are between 900 and 2000 feet in elevation, considerably higher than the railroad points. The climate is so mild that mining, even on the surface, can be carried on practically without interruption. Cost of hauling the ore to the railroad ranges from \$1.25 to about \$5.00 a ton, depending on the season as well as on distance.

Up to 1896, when the last of the California chrome miners were forced out of business by cheap imported ores, San Luis Obispo County had produced 30,000 tons¹ of chromite, most of which carried over 50% Cr_2O_3 . The first plant in the United States for concentrating chromite was built at San Luis Obispo in 1893, as it was realized even then that high grade bodies near the railroad were being exhausted. Recent operators have opened up many old properties, and have also made new discoveries. Present high prices justify extensive underground exploration which would have been unwarranted previous to 1915. These prices have also stimulated, here as elsewhere in the state, the search for ore in regions where the cost of hauling would have absorbed all profit at pre-war figures.

Principal producers are the New London, Pick and Shovel, Trinidad and Castro, all familiar names 20 years ago. All these but the Castro have been shipping fairly high grade ore. New underground exploration in the Pick and Shovel (which had 2500 feet of old tunnels) has revealed new lenses of ore, one said to contain 1000 tons. Similarly, tunnels in the New London have developed numerous lenses. These lenses are often connected by stringers of low grade ore which serve as indicators to the miner. In a given mine, it is sometimes noted that

¹Mines and mineral resources of Monterey et al. counties: Cal. State Min. Bur., p. 80, 1916.

lenses thus connected have the same pitch, but there is no concordance in pitch in the lenses at different properties. No contact deposits are reported here, but many of the best bodies of chromite have occurred near the borders of the serpentine. These deposits should not be confused with quartz veins deposited in "true fissures." The fissure, in the case of quartz veins, has been a controlling factor in the deposition of vein material. In the case of chromite in serpentine, the more rational conclusion seems to be that the fissuring, if any is observable, occurred after the mineralization, and was quite likely due to forces of expansion and readjustment within the rock, while the increase in volume coincident with serpentinization was going on.

Concentration is being carried on successfully at the Castro on disseminated ore running from 20% to 25% Cr_2O_3 , and at the Norcross on ore of lower grade. The undeveloped and slightly explored area between this group of mines and the northern county line, in a northwesterly direction through Pine Mountain, offers possibilities which would stand more chance of development if a more liberal policy were exhibited by the large land owners.

Recent advice indicates that the productive San Luis Obispo County chromite belt has been traced northwestward into Monterey County, where a promising prospect is being developed west of Jolon. Ore from this district will be hauled to King City, 28 miles distant, by auto truck, but about eight miles of road-building will be required before hauling is begun.

Some small bodies of chromite had been observed in Santa Barbara County, but no production made previous to 1918. Recently, good-sized bodies of high grade ore have been opened 12 to 15 miles southeast of Los Olivos and one company reports having shipped over 500 tons of ore, averaging about 50% Cr_2O_3 , this year, with much more in sight.

Tulare and Fresno Counties.

The Tulare County deposits are in serpentine belts striking northwest, in the large area mapped as "Plutonics," by J. P. Smith.¹ This region slopes up sharply from the valley to the highest peaks of the Sierra Nevada and has been only slightly explored by miners and geologists. The principal production in this county came from the Vaughn Mine, four miles southeast of Porterville, in 1916. At present there is little ore being produced; a reported yield of 3435 tons in 1916 was followed by the production of scarcely 500 tons in 1917. About one-half of this came from the Vaughn property which was considered worked out the previous year.

¹Smith, J. P., The geologic formations of California: Cal. State Min. Bur., Bull. 72 and accompanying map, 1917.

Fresno County has chromite deposits in the serpentine associated with the Franciscan formation in the extreme southwest corner of the county as well as in the Sierra foothill belt. The former are unimportant. There is an immense area of serpentine a little farther north along the San Benito-Fresno counties line, just south of New Idria, but it seems to carry only a little chromite, though quicksilver is prominent in it. The principal production of chromite has come from the Watt Valley district. Fresno County was the second largest producer of chromite in the state in 1916, but production dropped from over 9,000 tons that year to scarcely 6000 tons in 1917, and as far as can be judged there will be a slight falling off again in 1918. There have been several small producers whose total output amounted to 4 or 5 cars each. Ore from the Watt Valley district is hauled to Clovis, about 24 miles distant, at a cost of \$4.75 to \$6.00 a ton. Other shipping points are Sanger, Piedra and Coalinga. Hauling from the Pine Flat district to Piedra costs about \$3.00 a ton. The most expensive haul is to Coalinga, from the areas east of Stone Canyon and south of New Idria.

Concentration is being introduced in Fresno County and three plants were projected early this year, but so far as known are not yet completed. The Franciscan area near New Idria and Hernandez holds out some promise of developing a body of disseminated ore but there has not been enough work done here to show what tonnage of such ore is available.

Counties West of San Joaquin Valley.

The counties of Alameda, Santa Clara, San Benito, and Stanislaus all contain areas of Franciscan rocks with which are associated serpentine carrying chromite. Production from Alameda County has been practically all from the Newman Mine, 15 miles southeast of Livermore. Total production here has been about 3500 tons. Production in Santa Clara County has amounted altogether to about 500 tons, mostly from the Winship properties. Similarly, the amount of chromite so far produced in San Benito County has been insignificant, in spite of the great area of serpentine in the southeastern corner of the county. The Stanislaus chromite deposits are in the serpentine belt which includes the chromite properties in Alameda County. Chromite occurs here, as in Alameda County, both as massive hard black ore and soft grayish ore, grading into serpentine. Reported production to date has been about 2000 tons, mostly sold in 1917. Chromite mining was made possible here largely by the building of a narrow gauge railroad westward from Patterson, and the properties so far productive are adjacent to this road, at points from 19 to 23 miles from Patterson. Future development will no doubt be chiefly in the immediate neighborhood of the

road, because of the rough nature of the country. Concentration is already being provided for by the erection of a custom plant of 50 tons capacity, 21 miles west of Patterson on the narrow gauge line. A large tonnage of ore said to assay 25% to 30% Cr_2O_3 has been developed and will be concentrated. Other owners control over 5000 acres of land in the district which has not been thoroughly prospected, but is known to show numerous small outcrops. The county may, therefore, be safely included among the moderate producers for some time, although developments to date do not warrant any hope of a big yield.

Coast Ranges, North of San Francisco Bay.

The Franciscan area beginning in Marin County extends thence northwest through Del Norte County, being flanked on both sides by Cretaceous rocks. In the present state of our knowledge, the greater parts of Sonoma, Napa, Lake and Mendocino counties are considered as being covered by the Franciscan, but there are of course through this district many small residual areas of Tertiary rocks as well as minor deposits of Quaternary terrace gravels, and eruptives such as those which flank both sides of Napa Valley and extend to Clear Lake. The region had already been known to geologists principally by reason of the quicksilver deposits of Napa and Lake counties. Mendocino and northern Lake County, as well as the southern part of Humboldt and Trinity counties, comprise a *terra incognita* where no general systematic geological study has been made.

The greatest handicap suffered by this district is lack of transportation. The lenses of massive chromite so far developed have been small, but a great deal of low grade disseminated ore is reported. A little over 500 tons of chromite has been shipped from Cazadero, Guerneville and Geyserville, having been mined in the serpentine in the western part of Sonoma County. There are no other chromite bodies known at present and no definite promise of future production from that county. In Napa County reported production has scarcely exceeded that in Sonoma and at the beginning of 1918 there were only two owners in the county who reported promise of further yield, although prospecting is going on in the Franciscan area east of Calistoga. Lake County has yielded about 2500 tons of chromite during the two years of 1916 and 1917, and two-thirds of this production was made in 1917, but there are no promising developments on foot now, and it is problematical whether or not production can be maintained at anything like the rate of the past year. The principal producer reports little ore left. Ore shipped so far has been taken out near the surface, with the exception of a few carloads mined on the property of the Great Western Quick-

silver Mining Co., where the ore body was covered with such an overburden that mining cost promised to become prohibitive. The ore in general is high grade, and most of it has been used by a local tanning company in making chemicals. The good quality of the ore, which ranges from 45% to 52% Cr_2O_3 , is attributable to its superficial character, and the removal of impurities by weathering. Ore from the Lucky Strike Mine in Morgan Valley is hauled by trucks directly to the Napa chemical plant, a distance of 60 miles at a cost of \$8.00 a ton. Other producers have been hauling their product to Calistoga, the principal railroad shipping point for the county, the cost being around \$5.00 a ton. Properties so far reported lie between Lower Lake and the region of Mt. St. Helena.

Mendocino county has so far been the smallest producer of this district, but holds out some promise because of the many prospects located there. Notable among these is the float ore on Big Red Mountain. About 100 claims have been located here, but not enough work has been done to determine the presence of ore at depth, and until such ore is developed we must assume the deposit to be of superficial blanket character resulting from the breaking up and scattering of ore bodies. A road passes one mile west of the prospects and the nearest point on a railroad is Longvale, 30 miles distant. A deposit of disseminated ore four miles northeast of Largo, a station on the railroad, has been prospected by the Noble Electric Steel Co., but they did not develop a large enough body to warrant erection of a concentrating plant. Deposits on Little Red Mountain, just north of Big Red Mountain, show widespread distribution of chromite on the surface, but lenses in place have not been developed.

Klamath Mountain Region.

This division includes, so far as this report is concerned, Del Norte, Siskiyou, Trinity and part of Shasta counties. Considerations of geological age and structure have led to distinctions being drawn between this region on the one hand, and both the Coast Ranges and Sierra Nevada on the other. The country includes California's portion of the old eroded land surface known as the Klamath peneplain, which is held by Diller¹ to have been mostly dry land during Cretaceous and Tertiary times, when the valley on the east and the coastal region on the west were being mantled by sediments. The rocks exposed in the Klamath peneplain region are generally conceded to be Carboniferous and older, but there is such a scarcity of fossils that determinations of age by paleontology are not generally possible. There is strong probability that there are numerous areas of rocks here younger than the

¹Diller, J. S., Topographic development of the Klamath Mountains: U. S. Geol. Surv., Bull. 196, pp. 1-69, 1902.

Carboniferous system, as the greater part of the district, like the counties to the south, has never been studied in detail, except for small areas in central and eastern Trinity County.

Serpentine occurs widely distributed. In Del Norte County there are two broad zones of it. All the producing chromite mines so far opened are in the western area which traverses the entire county at an average distance of 8 to 10 miles from the coast, being over 12 miles wide at the state line. This serpentine is associated with numerous intrusive bodies generally described as diorites, but probably better classified as greenstones, as no work has been done to definitely classify them. The two largest chrome mines in the county are located near the contact of serpentine and the so-called diorite. These are the old Tyson properties known as the French Hill and Low Divide Mines. These mines have produced practically all the ore yet shipped from the county. The chromite is massive, black and of high grade, running from 46% to 51% Cr_2O_3 , but appearing to be even higher grade, because of the high iron oxide content. East of the Low Divide, on the High Plateau, numerous prospects have been located during the past year which promise well. These claims are very inaccessible, being separated by rugged, roadless country from both the Crescent City and Grants Pass roads. It is probable that only limited tonnages can be shipped from here for some time to come. East of French Hill another group of new locations is being prospected, and some production will probably be made in 1918. These claims are near forest trails at points from 3 to 18 miles from the nearest road, which ends on French Hill near the Tyson mine. Transportation is a vital question to the miners in this county, and is entirely inadequate as will be seen by reference to the body of this report. Production in 1918 will probably be from the Tyson properties and from the newly located Hawkins and Young properties which are being opened. There remains in this county an immense area of potential chrome producing territory, extending from the Klamath River northward in the west belt, and on the east side of the county. The latter area will probably be opened from the Siskiyou County side, and development there will depend on the degree of success attending efforts to open up deposits on the same belt in Siskiyou County.

Deposits so far productive in Siskiyou County are in general scattered, small bodies, there being only one property, near Dunsmuir, which had yielded over 300 tons up to the end of 1917. There are, however, some new districts being opened near the Klamath River, one being the Gottville district and the other between Happy Camp and Somes Bar. Sixty men are said to be now employed extending the road down the river from Happy Camp to tap the latter region, from which ore will be hauled in trucks to Hornbrook. A considerable

tonnage of ore running 30% to 45% Cr_2O_3 is said to be ready for hauling from the two districts. The cost of hauling from Gottville to Hornbrook, 18 miles, is stated to be \$4.50 a ton. Another body of low grade, said to be quite extensive, has been opened on the north side of the Klamath near Hamburg, 48 miles from the railroad and unfortunately separated from the road by the river. A tramway or bridge will be required, and the haul to Hornbrook would cost probably in excess of \$12.00 a ton. Ore from the small mines in the Callahan district is hauled 35 to 40 miles to Gazelle at high cost, and from Scott Valley district ore is hauled to Yreka. The Coggins Deposit, which is an extension of the Little Castle Creek deposit in Shasta County, is near Dunsmuir on the railroad. It has produced more chromite to the end of 1917 than all the other properties in the county.

Production from Trinity County has been negligible so far, but at the Crow Creek property, 18 miles west of Castella, about 2000 tons is said to be blocked out, with 1000 tons mined early in 1918, awaiting completion of a road. Aside from this property the only other production reported to the credit of the county came from small lenses mined in 1916 on the upper waters of Hayfork near Wildwood, distant about 58 miles by road from Redding, and from property mined for a few months in the summer of 1917 near Auto Rest, from which place ore was hauled 84 miles to Red Bluff by auto truck at a cost of \$13.50 a ton. As noted in the description of Trinity County properties, there are a multitude of small prospects in the county, but the season for hauling is short and in most cases the properties are so remote from the railroad as to seriously hamper their development. The Crow Creek region may be reasonably looked to for new development this year, in addition to that at the Crow Creek mine itself.

The productive area in Shasta County is in the northwestern corner of the county west of the railroad, between Shotgun Creek and the Siskiyou County line. Three properties here have produced over 21,000 tons, of which amount more than 15,000 tons came from the Little Castle Creek Mine. The bulk of this was mined in 1916. The Little Castle Creek ore body has apparently been exhausted. The Shotgun Creek property, which yielded well in the past, was prospected in 1917 but reported no production. The Forest Queen, a big producer in 1916, showed a falling off of 65% in 1917. The district is promising for further production but there have been no developments to date during 1918 which warrant us in looking for heavy yield this year.

Counties on West Side of Sacramento Valley.

Tehama, Glenn and Colusa counties form a group whose western portions are linked geologically with the coast counties, but are accessible only from the valley to the east. Franciscan rocks form the eastern

slope of the Coast Ranges and extend well down toward the valley, the contact with unaltered Cretaceous sedimentaries being easily traced. Serpentine is prominent near the contact, in the Franciscan series, and extends for miles in areas broken by frequently occurring buttes of chert, which has proven so resistant to weathering that its massive portions form the prominent topographical features.

Tehama and Glenn Counties have made considerable production, but Colusa County has so far not reported any ore shipped, although there are numerous prospects in the region of Stonyford and Wilbur Springs, at distances of from 25 to 35 miles from the railroad at Fruto and Williams. The most promising property in Tehama County is in the extreme northwest corner on Tedoc Mountain. From here to Red Bluff the haul is 53 miles, over twelve miles of road having been recently built to reach 20 claims which have not been developed much yet, but are known to carry a great deal of float ore. Production in 1917 was from near the surface and the ore averaged 47% Cr_2O_3 . The haul costs \$8.00 a ton. Two properties 32 miles southwest of Red Bluff have produced considerable high grade ore in the past two years, being credited with a total of about 2500 tons. The haul from here to Red Bluff costs about \$5.00 a ton. A concentrator has recently been erected on the Kleinsorge property in the same district and ore said to average 6% over the entire surface of the mineralized zone ($\frac{1}{4}$ mi. x 2 mi.) will be concentrated. Further north, on Toms Head Peak, several hundred tons of 32% ore have been mined. This county will probably be one of the good producers in 1918. The working season is limited to the dry months.

The Black Diamond Mine of Glenn County has been one of the state's best producers, having a record of nearly 6500 tons. Over 3300 tons were shipped prior to 1893, and nearly 3000 tons in 1916. Production languished in 1917 and at last report prospecting was going on in search of new lenses, the ore in sight being about 30% Cr_2O_3 . Five other properties have yielded one to six carloads each. Ore from the Black Diamond was hauled 18 miles to Fruto. Some ore from other mines has been shipped from Orland. The outlook for 1918 production is not particularly promising.

Sierra Nevada Mountain Counties.

The counties grouped hereunder are those on the west slope of the Sierra Nevada Mountains beginning with Plumas on the north and extending south to and including Mariposa. Every county in this group has contributed to the production of chromite during the past two years, except Mariposa, which entered the list in May, 1918. It may also be said that production is on the increase in nearly every one of these counties and that the district will be at the front in

the list of producers for 1918. The mining of chromite in this district is practically a new industry. The presence of the ore has been known for years but the price obtainable had never been sufficient to justify mining. A few properties had been worked and a little production recorded, notably in Calaveras County, where the total tonnage mined was used in lining copper furnaces at the Campo Seco smelter.

The serpentine bodies carrying chromite are of widespread occurrence and show marked similarity. They are generally long narrow bodies, rarely over a mile wide, but often several miles long, with greatest length in an approximate north and south direction, conforming to the general strike of the country rock. There is no doubt that originally the rocks from which they are derived were in most cases injected as dikes and sills along contacts. Areas sometimes mapped as serpentine may contain a complex mixture of rocks not properly classified as serpentine. Passing through the region of Valley Spring there are several areas of serpentine which extend northwest and southeast clear across the Jackson quadrangle, partly intruded into the Calaveras (Carboniferous) rocks and partly into the contact with the adjacent schists. Similarly in El Dorado County, serpentine dikes are associated with the Calaveras formation. The great serpentine belt continues in this manner across Placer, Nevada, Sierra and into Plumas County. It has the aspect of having originally been intruded as an immense dike into the Carboniferous rocks, and in general follows the strike of these formations. The continuity of the surface of this belt has been broken at frequent intervals by later volcanic flows. The belt is wider here than to the south, and a number of associated rocks, some only slightly serpentinized, are mapped as serpentine. The occurrence of peridotite only partly altered, has led to the conclusion that this rock has in most cases been the original formation from which the serpentine came.

In the southern part of the belt, the occurrences of chromite so far mined have generally proven small. Of sixteen properties reporting production from Tuolumne County in 1916 and 1917, only two yielded over 500 tons each. Of these two, the larger carried ore ranging from 29% to 36% Cr_2O_3 . No large low grade bodies have yet been opened in the county, but it must be borne in mind that active production of ore did not begin here until 1917. Total reported production is about 3000 tons. The haul to railroad points is short, ranging from one to six miles.

Ore bodies in Calaveras County show the same characteristics as those of Tuolumne, and the production to date has been about the same, with only one property reporting over 300 tons shipped. Valley Spring, Milton and Angels Camp are each the terminus of a railroad line, and ore has been hauled to these points chiefly. The cost per mile of hauling ore

is high because of poor roads. An eight mile haul to Angels Camp costs \$3.00 a ton; another producer hauls ore 15 miles to Milton at a cost of \$6.00 a ton. Prospecting is active, and small bodies continue to be found. The mild winters in this belt do not hinder continuous mining but hauling is interrupted by muddy roads. Grade of ore shipped is similar to that in Tuolumne County. One concentrating plant is in operation six miles from Copperopolis.

Amador County has been the smallest producer of the group to date and is probably the least promising of them, but prospecting is active, many gold miners having abandoned their old pursuit to search for chromite.

El Dorado County has been one of the chief producers of chromite, ranking third in the state in 1916, first in 1917, and bidding strongly for first place in 1918. While there have been and still are large shipments of good grade crude ore, the county is of special interest because of the extensive application of concentration to low grade chromite ore. The high grade bodies have been usually small chimneys and lenses which could be exhausted by shallow workings, seldom over 100 feet deep. Low grade bodies have been encountered while taking out these small pockets and shipment of crude ore averaging 35% to 45% Cr_2O_3 continues at many properties, while mills are being built to concentrate the disseminated ore. Total reported production in 1916 and 1917 from the county was over 13,500 tons, nearly all crude ore. Folsom and Newcastle are the principal shipping points. It costs \$2.50 a ton to haul from the Pilliken property to Folsom, nine miles distant, and about \$1.50 a ton to haul eight miles from the Zantgraff district to Newcastle.

Five chromite concentrating plants are reported either in operation or in course of construction in the county in July, 1918. The plant of the Placer Chrome Co. near Rattlesnake Bridge on the Middle Fork, American River, has been enlarged to 100 tons capacity with the addition of another Hendy ball mill and several improved concentrators. Electric power has been installed. Holbrook and McGuire have two concentrating plants on the Darrington Lease, eight miles from Folsom, handling ore containing 8% to 15% Cr_2O_3 . The Noble Electric Steel Co. has one mill nearing completion on the Pilliken Ranch, and one being built on the Burnett Ranch. The product of these four mills will be shipped from Folsom. The ore to be milled is stated to not exceed 25% Cr_2O_3 . No figure of tonnage available for milling can be quoted. Production from the last two mills has been delayed by the failure of the crushing machinery originally installed to stand up under the work. The company is now building new mills on the general pattern of the Ellis-Chili Mill, but heavier and sturdier in all respects. With all these mills in operation, chrome concentrate averaging 45% Cr_2O_3 or better will form probably one-half, at least, of the county's 1918 production.

Placer County was, in 1917, third among the principal producers in the state, yielding over 4200 tons. Only one producer reported over 1000 tons from a single property, and his production came from a number of small superficial kidneys taken from the surface. The Iowa Hill and Forest Hill districts were then, and continue to be now, the most productive localities, although ore is being mined farther south on the ridges lying between the forks of American River, and on the north side of the railroad. Cost of trucking is high. A haul of $27\frac{1}{2}$ miles from the Forest Hill divide to Colfax costs \$7.50 a ton. The North Fork of American River flows in a steep cañon, and there is a long upgrade to the railroad. Hauling from the mountain districts with trucks is halted by winter and the dirt roads are rapidly ground to deep dust by heavy traffic in summer. One concentrating plant has lately been built near the Auburn-Grass Valley road, about five miles from Auburn. There is said to be a good tonnage of ore averaging 20% Cr_2O_3 , but the ore body has not been blocked out at last report. There has been about one car load of concentrate carrying 40% to 45% Cr_2O_3 produced to date. Changes in crushing and concentrating machinery are contemplated, which are going to delay further production for some time.

Nevada County's total production of about 3000 tons in the past two years has been shipped chiefly from Nevada City, having been mined principally near there and in the neighborhood of Washington. The longest haul is 20 to 25 miles. The Oustomah and Champion stamp mills at Nevada City have been put in shape lately for concentrating chromite. An ore carrying 12% to 20% Cr_2O_3 is giving a concentrate containing 32% to 36% chromite, which is used in California for making chemicals.

Sierra and Plumas counties have not been heavy producers of chromite so far. These counties are not only very mountainous, but are also remote from transportation for the most part, and the season for hauling is not generally over six months. Chromite is now being mined and shipped from the vicinity of Downieville and from near Alleghany. Some shipments are being made from Blairsdien in Plumas County.

DEVELOPMENTS DURING FIRST HALF OF 1918.

No new districts have been opened this year, but the productive areas are being enlarged by the stimulation of prospecting due to sustained demand and good prices.*

In the south, small shipments have been made from the vicinity of Los Olivos, Santa Barbara County. In San Luis Obispo County a new concentrating plant is being built by H. H. Noble on the northeast

*See supplementary statement on p. 227, *post*, re late break in the chromite market.

side of the Santa Lucia Mountains on the Liberty Group of claims four miles from Santa Margarita. This is the first development of importance on the north side of the range.

At the north, Humboldt County has entered the list of producers, the initial shipment of chromite having been reported June 13. The ore comes from near Peewan Creek and is taken down the Klamath to Requa in Indian "dugout" canoes. Early production is probable from the Horse Mountain Copper Company's claims, 25 miles by road from Eureka. These properties are in the same belt of serpentine which traverses Del Norte County and the development of chromite was to be expected. In Del Norte County, the High Plateau is being made accessible by a new road. Responsible operators have taken hold of the new properties in the Gordon Mountain district (see Young and others) and greatly increased production from the county is probable this year. Improved steamer service or direct connection with a railroad will be found very desirable, if not imperative, here. Strong interests have also taken hold of new properties three miles from Hamburg in northern Siskiyou County and a bridge is being put across the Klamath there. (See Chromite Group).

INCREASED IMPORTANCE OF CONCENTRATION.

With nineteen plants for concentrating chromite either in operation or in various stages of construction, it may be seen that concentrates will form a large part of 1918 production. Any prediction of the future of this branch of the industry now would be idle, as little definite development work has been done, and operators have not generally gone farther than to satisfy themselves that they have enough ore to justify building a mill. Burch and Dolbear¹ estimate the cost of a 50-ton plant at \$15,000. To the writer's personal knowledge, four or five plants which were hastily built with cheap crushing machinery are now being re-equipped and will be delayed in entering the list of producers. Slime losses have been serious at some properties where ball mills or Huntington mills were used originally without appropriate slime tables; but with standard equipment, concentration of chromite offers no particular difficulties. There are some districts where the iron oxide content of the ore is so high as to limit the percentage of chromite in the concentrate, but usually it is possible to get a product of higher tenor than the crude ore available. Some operators claim to be making concentrates carrying as high as 50% Cr₂O₃.

¹Chromite. A. Burch & S. H. Dolbear. Printed by M. & S. P., 1918.

DISTRICTS OF PROMISE TO THE PROSPECTOR.

The serpentine areas of the state have never been mapped in detail and in many cases are too small to indicate on a state map on a scale convenient for publication. The counties north of San Francisco Bay and west of Sacramento Valley probably offer the best field for prospectors in search of chromite. As noted before, most of Mendocino and Lake counties are covered by the Franciscan formations of the Coast Range province. In this province are also located the western mountainous portions of Colusa, Glenn and Tehama counties and the central part of Humboldt. The serpentine areas which are of almost constant occurrence with the Franciscan rocks have not been carefully prospected because of the roughness of the country and almost entire absence of transportation facilities.

The Klamath province, including eastern Humboldt and Del Norte and western Siskiyou and Trinity counties, is still more remote from transportation, and is not accessible in winter except near the large streams, like the Klamath. Because of these limiting conditions in the above districts a prospect of chromite must show promise of developing considerable ore in order to justify the expense of opening it and getting ore to market. In this respect, the small producers in the Mother Lode counties have a distinct advantage, as they are usually within a short distance of the railroad and can market part carloads if necessary.

MINES.**ALAMEDA COUNTY.**

Chromite occurs in the serpentine areas which are common to the Franciscan group in the southeastern portion of the county. (See Plate II, *ante*, under Manganese.) The only important deposits known are those which occur on Cedar Mountain and which were first mined years ago. It is reported that over 3000 tons were mined from this locality, most of which was produced from the Newman property described below.

Clark Claim, Vernon Clark, Livermore, owner. This is on Sec. 26, T. 4 S., R. 3 E., M. D. M., just east of the Newman Mine. It is worked through an incline shaft, and some chrome ore was shipped in 1916 by the Noble Electric Steel Company under a lease.

Newman Mine, formerly known as the **Mendenhall Mine**, lies about 15 miles by road southeast of Livermore in Sec. 26, T. 4 S., R. 3 E. E. C. Harder* in his description of this property writes as follows: "The ore occurs in irregular lenticular pockets and stringers in more or less decomposed serpentine. Where the serpentine is much decomposed it is soft and broken and has a brown stain. The chrome ore that occurs in this rock is generally soft and friable and of a dull grayish-

*U. S. G. S. Bull. 430, pp. 173-174.

black color, but that in the fresh serpentine is glossy black in color and contains very little intermixed serpentine. Some masses of fairly compact ore are found within pockets of soft ore, as if they were not yet thoroughly disintegrated."

Development consists of several open cuts and tunnels. The larger lenses or pockets appear to have been exhausted, and the little ore remaining in sight on the working is of low grade. Considerable work was done here by the Noble Electric Steel Company during 1916. They mined and shipped several hundred tons to their smelters at Heroult. In October, 1917, it was under lease to J. W. Clark and D. McDonald, Livermore, and shipments of ore resumed. S. V. Newman of Livermore is the owner.

Bibl.: Cal. State Min. Bur. Reports XII, p. 36, XIII, p. 48; Bull. 38, p. 267. U.S.G.S. Bull. 430, pp. 173-174.

AMADOR COUNTY.

The **Carr** and **Mefford** properties lie in Sec. 34, T. 6 N., R. 10 E., M. D. M., two miles south of the Amador Central Railroad near Ione. They include 80 acres on which chrome ore occurs as lenses and chimneys in serpentine.

The ore bodies have been developed by open cuts and shallow shafts. No. 1 workings are on the Mefford property in the W. $\frac{1}{2}$ of the S.W. $\frac{1}{4}$ of Sec. 34, at an elevation of 900'. These followed an orebody which struck north-south and dipped 75° west. A cross-cut struck chrome at 10' below the surface and the ore body was worked southward by open cut for 40' and tunneled for an additional 10'. Near the center of these workings a 20' incline followed an orebody which was 4' wide at its center. It is reported that 65 tons of 35% ore were shipped from here during the year 1916. Below these workings at an elevation of 850' about 15 tons of ore were taken from an open cut 20' long, 4' deep, and 6' wide in the center.

No. 2 workings, at an elevation of 850', lie south of No. 1 workings.

Chimneys of ore were worked to a depth of 20', and yielded 48 tons in 1916.

No. 3 workings, at an elevation of 830', lie north of No. 1 and consist of a cross-cut tunnel which struck the orebody at 20' and followed it for another 20', at which point an 8' raise was run to the surface. A body of ore just being opened up measured 2' wide and 8' long, and had a strike N. 20° W. and pitch 65° E. Approximately 25 tons of ore for shipment were in a pile on May 26, 1917.

On the Carl Froelich property, about 800' southwest of No. 2 workings, a 70' incline shaft was sunk by Bauers, Case and Swanson in 1916. The orebody narrowed, and when visited was covered by waste. On the

ridge east of this shaft, at an elevation of 920', a 16' incline took the heart out of another ore body which appeared to continue northward along a 4" leader of chrome. On the east side of the ridge at an elevation of 730' another lens of chrome struck N. 15° W. and dipped S.W. into the hill. Approximately 2' of ore is said to have been left in the bottom, and it seems probable that more ore could be taken from the north end of the pit.

Approximately 365 tons of ore were shipped from these properties in 1916.

Owned by J. E. Mefford, Mr. Mooney and Carl Froelich, and operated by E. H. Carr and J. E. Mefford of Ione.

The **Courtwright** property adjoins that of Carl Froelich on the south. It lies in Sec. 2, T. 5 N., R. 10 E., M. D. M., at an elevation of 875'.

The lower workings consist of a 14' incline shaft on an orebody that was 20' long and 6' wide. The lens of chrome struck north-south and pitched 65° E. About 10" of ore, now covered by 4' of waste rock, is said to have shown in the bottom when work was abandoned. Approximately 500' south of these workings an open cut was made 8' wide and 30' long. Ore is said to have persisted in the bottom of the east end of this cut, but work was abandoned. Another open cut, at an elevation of 875' about 40' southeast of the last, followed a stringer striking N. 35° W. and pitching 65° E. These workings are 6' wide, 8' deep and 16' long, and expose a 4" stringer of chrome in the hangwall.

Approximately 60 tons of ore assaying 40% Cr_2O_3 and 4% SiO_2 were shipped in 1916.

The **Detert** ranch is located on the south side of Cosumnes River in Sec. 6, T. 7 N., R. 10 E., about eight miles northeast of Carbondale. Lenses of chrome ore occur in serpentine on a hill northwest of the ranch house.

Ore mined on this property about 22 years ago was left in the dump until recently, when 80 tons were shipped by way of Carbondale. More ore could probably be obtained by deeper work.

Owned by W. F. Detert, 995 Market St., San Francisco.

Dooley property. About 10 tons of 38% ore has been mined on the property of E. A. Dooley still farther north along the same serpentine belt, as the Wait property.

The **Wait** property consists of 160 acres in the NW. $\frac{1}{4}$ of Sec. 29, T. 7 N., R. 10 E., M. D. M. It lies five miles southwest of Plymouth near Willow Creek.

Three parallel lenses of chrome ore, offset one from another, in serpentine were mined by an open cut 20' deep and 60' long. The ore is said to

have averaged 38.7% Cr_2O_3 . Float chrome has been found at intervals for one mile southward. Two 40-ton cars of ore were shipped in 1916.

Owned by A. L. Wait of Plymouth. Mr. Wait mined about 5 tons of 26% ore on the Matthews property adjoining him on the north. This ore was along a contact of serpentine and pink marble.

BUTTE COUNTY.¹

Agard and Stewart of 268 Market Street, San Francisco, hold a lease on railroad land in the E. $\frac{1}{2}$ of Sec. 36, T. 23 N., R. 4 E., M. D. M. The property lies at an elevation of 2500', more or less, about one mile southwest of Pulga, or Big Bar, on the Western Pacific Railroad.

A body of 45-50% chrome ore, striking N. 15° W., was being worked about one-half mile west of the camp, near the road to Big Bar. The lens was 5' wide in the center and 20' long, and had been worked to a depth of 18'. Ore in the bottom of the workings was exposed 30" wide and 10' long and appeared to be widening. In the south end of the orebody, down to a depth of 10' about 2 tons of a 28% granular chrome ore was mined but not shipped.

Work was being carried on by two men who carried the ore in powder boxes from the pit to a platform, from which it was hauled by team to a second platform. The ore was hauled to Oroville for \$8.00 per ton by two Ford auto trucks, which carried about 2700 pounds each. About 18 tons of 45-50% ore was corded on the platforms ready for shipment.

About one-half mile N. 30° W. from the last workings about 80 tons of a lower grade ore, carrying considerable serpentine, has been mined. It lies on the south slope near the summit of the mountain, and a road must be built before it can be hauled.

Another deposit of high grade ore, said to be mined out, was located about $1\frac{1}{2}$ miles east of the camp and hauled to Big Bar.

One car of ore had been mined and shipped from Oroville up to the middle of July, 1917.

The **Hendricks** property lies at an elevation of 1600' one mile east of Yankee Hill in Sec. 34, T. 22 N., R. 4 E., M. D. M. The property is owned by Charles and William Hendricks of Magalia, and leased by Mr. Cashom and F. A. Alexander of San Francisco.

A lenticular body of chrome ore in serpentine struck N. 45 W. and dipped 80° NE. It was worked by an open cut 100' long, 5' wide and 20' deep, and by a winze 14' below the floor of the open cut near the center of the workings. The ore body appeared to have been 5' wide in the center, tapering both ways for 40' in length. In the deepest part of the open cut 30' below the surface, the ore pinched.

¹Since the preparation of this report, two new concentrating plants have been projected. These will be built by A. A. Davis of Oroville, and John D. Hubbard of 832 Mills Bldg., San Francisco. Hubbard's mill will be erected on the Lucky John Mine, at Paradise.

The ore was granular and had considerable serpentine frozen to it. About 50 tons of 35-38% ore was corded, ready for shipment. Hauling to Oroville would cost \$8.00 per ton.

Mr. Cashom was said to have mined out some ore on the J.-G. Curtis property in Sec. 7, T. 21 N., R. 4 E., M. D. M., near the Pacific Gas and Electric Company's power house. About 100 tons were mined in 1916 and 28 tons in 1917.

Mr. Wm. Hendricks was said to have about 30 tons of 38% ore mined in Sec. 6, T. 21 N., R. 4 E., M. D. M. A road was to be built in order to haul the ore.

The **Lambert** property lies at an elevation of 1270' in Sec. 34, T. 23 N., R. 3 E., M. D. M., about 5 miles southwest of Magalia. The location made by Nat Lambert, was leased by the Union Chrome Company of San Francisco.

The northernmost workings are on the east side of Middle Butte Creek. A body of ore striking north-south had been mined, leaving a pit 6' wide, 10' long and 15' deep. The walls of the pit were partly caved because of the fractured nature of the serpentine walls which were insufficiently timbered. This pit was to be cleaned out with the hope of opening up more ore.

On the west side of the creek about 50' south of the aforementioned workings an ore body striking N. 30° W. has been opened up. The main ore body was 16' long, 8' wide in the center, and had been worked to a depth of 12'.

Equipment consisted of an 8 h.p. Corliss gas engine directly connected with a hoist at the head of a 1120' tram with $\frac{1}{2}$ " steel cable. The tram car will make 22 trips a day, carrying 1500 lbs. to the car.

The cost of hauling the ore from the head of the tram to Magalia, a distance of 4.7 miles, was \$4.00 per ton.

Approximately 100 tons of 45% ore were corded at the head of the tram, and probably there was about as much more ore in sight at the mine on July 16, 1917. About 189 tons of ore were shipped from Magalia in May, 1917.

The **Lucky Strike** property lies one mile north of Woodleaf. Chrome was located on the properties of the Southern Pacific Railroad and the Butte Pine and Hardwood Lumber Company by Chas. Falk of Woodleaf.

Brendt No. 1 claim is located $\frac{1}{4}$ mile below the old Townshend mill on the lumber company's property. About 300 tons of ore are said to have been taken from a lens 8' wide in the center by 50' long, and varying in depth up to 12'. These workings are now caved and filled. The ore struck N. 45° W. and dipped 80° SW. with a footwall of decomposed

serpentine and hanging wall of serpentized talc schist; it probably ran 45% Cr_2O_3 . The ore was shipped by Dickey and Driesbach of Oakland.

The same operators have mined about 35 tons of 35% chrome ore about $\frac{1}{4}$ mile west of the residence of E. C. Binet, near Clipper Mills. The soil at this deposit was about 6' deep, and the ore was taken from a pit 8' wide, 10' long and 10' deep. The ore was granular and considerable leopard chrome was associated with it. On July 13, 1917, the ore was still in a pile near the road, awaiting shipment.

Norris and **Noyes** of San Francisco were reported in November, 1917, to be developing chrome deposits east of Brush Creek in Sec. 11, T. 21 N., R. 6 E., M. D. M. A car or two will probably be shipped in 1917.

The **Rohrer** and **McCrosky** property consists of two claims in the SE. $\frac{1}{4}$ of Sec. 36, T. 23 N., R. 4 E., M. D. M. These, the Twin Cedars claims, lie at an elevation of 3000' and have a fair growth of cedar and yellow pine.

A lenticular body of chrome ore striking north and south in serpentine has been developed by open cut. Approximately 27 tons of chrome ore had been corded for shipment by way of Oroville, 28 miles distant.

Owned by G. C. Rohrer and Jess McCrosky of Big Bar.

The **Sharrer** property is located $\frac{1}{4}$ mile northeast of Woodleaf in Sec. 10, T. 19 N., R. 7 E., M. D. M., at an elevation of 3050 feet.

Float chrome which would probably run 30% has been followed in a north-south direction for 30 feet. No development work had been done.

Western Ore Co. Mine and mill six miles east of Paradise. A. E. Vandercok and E. H. Nash, First National Bank Building, Oakland, owners. This plant was being completed at the time of our last report. As then planned, the ore is to be crushed to $1\frac{1}{2}$ " in a 6"x8" Dodge crusher and put through a 5-foot Huntington mill with 20-mesh screen. After classification, sands are to be treated on a No. 4 Deister concentrator and slimes on a Johnson vanner. Estimated capacity, 30 to 50 tons in 24 hours. Power is to be furnished by a 20 h.p. distillate engine. Mine ore said to assay 10% to 35% Cr_2O_3 . A 45% concentrate is looked for.

The **Wakehama** tunnel is located near the Lambert property in Sec. 35, T. 23 N., R. 3 E., M. D. M., about 5 miles southwest of Magalia, at an elevation of 1485'.

Boulders of 50% chrome ore were mined from the old drift mine tunnel, and 32 tons shipped by the Union Chrome Co., lessees, in 1917.

The **Zenith** mine is in Sec. 6, T. 19 N., R. 7 E., M. D. M. about $2\frac{1}{2}$ miles northeast of Forbestown at an elevation of 2940'.

Float chrome has recently been taken from the red soil and about three cars were shipped by Dickey and Dreisbach, the lessees, in 1917. No more ore has been taken from an open cut, which was worked in 1916. It is reported that a total of about 300 tons of ore had been shipped from the property.

Owned by the California Manganese Company of San Francisco.

CALAVERAS COUNTY.

The **Burnham Ranch** lies south of the Peri Ranch in T. 1 N., R. 13 E., M. D. M., southeast of Copperopolis on the north slope of the Stanislaus River. Wm. Burnham and brother are reported to have mined 10 tons of chrome ore, but none has been shipped.

The **Campbell** property lies near the Burnham Ranch southeast of Copperopolis. It is reported that 30 tons of chrome ore were mined in 1916 and shipped by the Mineral Resource Corporation of America.

The **Clary and Langford** lease includes the chrome deposits on the property of the Nassau Copper Mining Company in the NW. $\frac{1}{4}$ of Sec. 10, T. 2 N., R. 12 E., M. D. M. It lies 8 miles south of west from Angels Camp, the shipping point.

Chrome ore is being mined near the county road at an elevation of 1800'. A 40' incline shaft has followed the ore body, which strikes N. 30° W., and is exposed 2' in width on both sides of the shaft. The ore shoot has been mined to a depth of 27' for a distance of 30' northward. It appeared to continue southeast for at least 20'.

Two men were working with hand tools and windlass. Three cars carrying a total of 120 tons of ore were shipped to the American Refractories Company in May, 1917. The cost of hauling ore to the railroad was \$3.00 per ton.

Leased by Harry Clary, of Angels, and Geo. Langford, of Murphys.

The **Davis** property is located four miles northeast of Copperopolis in Sec. 14, T. 2, N., R. 12 E., M. D. M., at an elevation of 1740'.

High grade chrome ore occurs as lenses in serpentine. An ore body striking N. 60° W., exposed at the face of the workings, was 7' wide and 4' high with a 2' horse of serpentine; this was 10' from the southeast end of the lens which was being mined. There appeared to be about 20 tons of ore in sight at this lens which would assay over 40% Cr₂O₃.

Hauling to Milton, 15 miles west, cost from \$5.00 to \$6.00 per ton.

The **Hinch** property consists of five claims located seven miles west of Angels in the SW. $\frac{1}{4}$ of Sec. 3, T. 2 N., R. 12 E., M. D. M., in the Harmon Peak district.

Chrome ore occurs as lenses in serpentine and about 15 tons were mined, for use as furnace lining, by the Calaveras Copper Company

about 12 years ago. A considerable tonnage of good ore has recently been mined by F. W. Dean and Fred Wilson, who hold a lease from Mr. Hinch of Angels.

The **Lowry** property lies four miles west of Fosteria at an elevation of 1050' in Sec. 23 of T. 5 N., R. 10 E., and Sec. 30 of T. 5 N., R. 11 E., M. D. M. Mining is being carried on by Geo. Ward, who pays royalty to Geo. C. Lowry, the owner.

Development work consists of a 16' incline shaft, with windlass, on an ore body striking east-west and pitching N. 75° in serpentine. About 25 tons of 42% ore had been sledded to the top of the hill, while about 20 tons were in sight unmined. One quarter mile southeast of the shaft, at an elevation of 990', is an open cut 5' deep and 40' long on an ore body striking N. 20° W. and pitching 75° E. in serpentine. About 15 tons of 40% ore had been mined and was on the dump.

Approximately $\frac{1}{4}$ mile southeast of the Lowry ranch house, at an elevation of 1230', about 4 tons of ore had been taken from an open cut 3' deep and 8' long. The ore struck east-west in serpentinized amphibolite.

Hauling to the railroad at Valley Springs costs \$3.00 per ton.

The **Maxwell** ranch located near the Vogelgesang ranch, southeast of Valley Springs, is reported to have considerable low grade chrome ore in sight.

The **McFaul** property lies southeast of Copperopolis. A 30' shaft developed a good grade of chrome ore. It is reported that one car shipped in 1916 carried 49.4% Cr_2O_3 and 6.5% SiO_2 , while another car shipped in May, 1917, carried 47% Cr_2O_3 .

Owned by J. McFaul of Angels.

The **Peri** property is in the SE. $\frac{1}{4}$ of Sec. 6, T. 1 N., R. 13 E., M. D. M., at an elevation of 1300', 4 miles southeast of Copperopolis. It is leased from Frank Peri, of Copperopolis, by Frank Towers, Frank Reddick and Wm. Dixon.

Lenticular bodies of chrome ore strike east-west with footwall of serpentine and hanging wall of schist and metamorphic sandstone.

The main workings consisted of an open cut 14' deep and 30' long, in the west face of which ore was exposed 2' wide and 4' high. About 40' east of this cut a 20' shaft had been sunk with windlass. This incline followed a lower grade ore body which pitched N. 80° and was exposed 2' wide along the lower 5' of the east side. About 40 tons of 30% ore were on the dump and it was said that 48 tons of ore had been shipped in 1916. Open cuts on top of the hill had yielded 20 tons of ore and only small seams were left exposed.

The **True Blue** chrome mine lies 10 miles northeast of Angels Camp at an elevation of 2090'. It is owned by Mrs. S. E. Madrid of Angels Camp.

A lenticular body of chrome ore striking due east and west had been open cut 50' long and 12' wide in the center. Preparations were being made to run a crosscut tunnel for working the deposit at greater depth. It is reported that 600 tons of 30% ore were shipped from Angels Camp in August, 1916. Approximately 100 tons were ready for shipment with at least 125 tons of ore in sight unmined.

The **Vogelgesang** ranch chrome deposits are about five miles southeast of Valley Springs and one mile south of the Calaveras River. They are owned by G. D. Vogelgesang and Bros. of Valley Springs.

A series of lenses of chrome ore occur along a N. 45° W. direction for over 600'. The largest lens was reported to be 10' in width and 40' or more in length. The lenses pitch nearly vertical and lie in serpentine approximately parallel and 25' from its contact with amphibolite schist.

The ore is of good quality and some was used in the past for furnace lining at the Campo Seco smelter. It is reported that 150 tons of ore were shipped in 1916 and that the deposit was apparently worked out. Probably more ore could be obtained by deeper work.

The **Walker** lease includes chrome producing properties in Sec. 15 of T. 2 N., 2 12 E., M. D. M., 14 miles east of Milton Station, at an elevation of 1750'. Scattered open cuts were being worked about 1 mile east of the road from Angels to Copperopolis and approximately 1½ miles south of the branch road to Milton.

A 14' lens striking N. 45° E. and dipping 85° N.W. had been open cut 10' in depth and 25' in length, and there were 10 tons of ore piled for shipment. Another lens 500' west from the first was worked by open cut 6' deep and 40' long and had produced 20 tons of ore; this lens struck N. 45° E. and was 50' higher than the first. Three other small open cuts had been made, from each of which 10 tons of ore had been mined. An average assay of the ore was 39.7% Cr₂O₃ and 9.1% SiO₂.

Hauling to Milton cost \$5.00 per ton, and it was said that the ore was going to be shipped to the Union Chrome Co.

F. G. Walker, of Angels, superintendent.

COLUSA COUNTY.

Chrome Wonder Claim. Sam Sites, Stonyford, owner. On this claim near Stonyford, a shaft has been sunk, and about 4 tons of chrome ore are reported on the dump.

F. C. Innes, Wilbur Springs, has been working on the development of a chrome prospect near Wilbur Springs, since September, 1917.

Liberty Chrome Mine, Wesley Bradley, Stonyford, owner. Prospect.

The **Princess Chrome Mine** consists of 2 claims on government land $1\frac{1}{2}$ miles northwest of Cook Springs in T. 16 N., R. 6 W., M. D. M. Development work consists of an open cut 18' long and 10' deep from which a small amount of ore carrying over 45% Cr_2O_3 has so far been mined. An ore body 2' wide and 4' long is said to be exposed in serpentine. Owned by Jno. J. Sweeney, 1625 Haight St., San Francisco, or Stonyford, Colusa County.

Stella Chrome Mine, Elmer & George Evans, Sites, owners. They report a body of ore carrying 20%–40% Cr_2O_3 .

Teathers Chrome prospects. Cy Teathers, Stonyford, owner. Several chromite prospects are stated to have been uncovered on this foothill ranch near Stonyford.

DEL NORTE COUNTY.

Geology of Chromite Deposits.

A broad belt of serpentine, serpentized peridotite, and associated rocks, with numerous tongues of diorite, extends northerly through the county at an average distance of eight to ten miles from the coast, increasing in size from the south till it has a width of over two townships where it crosses the state line into Oregon. Farther east, along the Siskiyou-Del Norte counties line, is another belt of serpentine which extends northward through the watershed of the west branch of Illinois River and eastward toward the Klamath. Within these serpentine areas are found the producing chromite properties and the promising prospects of the county. There is still a large area of serpentine in these belts which has been unexplored by the prospector. The chrome ore occurs as lenses, some of which appear to be very extensive, with well-defined walls; and is the massive black chromite. Its content of chromic oxide varies from 40% to 50%, the ferrous oxide content varying up to 50%. The ore is deceiving in appearance, due to magnetite associated with it, so that it is impossible to approximate its chromic oxide content by mere observation. This black ore contains very little silica.

The ore bodies on the Tyson properties both at French Hill and near Low Divide, are notable because they are contact deposits, lying between well-defined walls of serpentine and diorite. These deposits have been large producers during the past summer. The deposits were first mined in the early eighties, but only a few thousand tons were produced. This was all shipped to Baltimore where the chrome industry of the United States was started. The difficulty with these deposits is their inaccessibility and for that reason they have lain idle

until the present demand for chromite as a war supply, for refractories, in the manufacture of armament, high speed tools, etc., increased its value.

Transportation.

The coast highway from Eureka passes through Crescent City and thence up the coast to Brookings, Oregon. Auto stages operate daily from Eureka to Crescent City, ninety-nine miles, carrying passengers and mail and requiring eight to nine hours for the trip. A daily auto stage also carries mail and passengers from Crescent City to Grants Pass, Oregon, via South Fork, Gasquet and Patrick Creek, a distance of ninety-five miles. A tri-weekly route operates from Crescent City to Brookings, Oregon. Freight service is furnished by small coast-wise steamers which have no regular schedule. The two chief chromite properties have roads for hauling, but any production from new prospects would have to be packed out over the different forest trails unless sufficient tonnage were developed to warrant new road construction of an expensive nature. Even in the case of those properties in the vicinity of French Hill, there is apt to be difficulty in delivering ore to the steamer at Crescent City in the rainy season (November to June) as there is a stretch of road between South Fork and the coast which became impassable for auto trucks with the first rain this fall (1917), and will probably remain so till summer unless given considerable attention. Arriving at the coast, another source of difficulty is found in the fact that the water at Crescent City is deep enough only for the smallest steamers, which are operated for the lumber trade and accommodate ore shippers only when space happens to be available.

Copper Creek Mine, also known as the **Low Divide Mine**, is situated in the Low Divide Mining District, in Section 35, T. 18 N., R. 1 E., about 15 miles northeast of Crescent City, the shipping point. This property owned by the Tyson Estate of Baltimore, consists of four claims, Mountain View Nos. 1, 2, 3, and Copper Creek, the latter being situated on Copper Creek about 800 feet in elevation below the other claims. Most of the ore shipped by the Tyson Mining Company was from the Mountain View Group, on summit of the ridge; but very little ore is exposed in those old workings. The deposit now being mined is on the Copper Creek Claim. A road was only recently constructed $1\frac{1}{2}$ miles, with an average 12% grade, up the ridge to connect with the Low Divide road to Crescent City. Here a large open cut had been made by the old company, and 700 tons of ore which is reported to average 44.6% chromic oxide and 3.2% silica, is piled on the dump. It was never hauled out, due to the decline in the price of chrome shortly after it was mined.

The ore body, which lies along a contact of diorite and serpentine, is exposed for a distance of 60 feet along its strike, north and south, varying in width from 6 to 10 feet. It dips eastward about 60° . Twenty-two feet below the floor of the open cut, a crosscut tunnel has been driven by the present operators. At 30 ft. it cuts the ore body, showing a width here of 16 ft. Thus it may safely be assumed that the ore body is continuous throughout this depth, and if this is so, there are at least 1000 tons in this deposit and probably a great deal more.



Photo No. 20. Copper Creek Chrome Mine (old Tyson Mine), Low Divide District, Del Norte County, showing 700 tons of ore on dump, averaging 45% Cr_2O_3 .

The mine is being operated under a sub-lease from the American Exploration Company of Portland by R. D. Adams and C. S. Maltby, Humboldt Bank Bldg., San Francisco, who expect to ship at least 50 tons daily during the season from this one deposit. Nine 5-ton auto trucks are hauling the chrome ore from this and the French Hill mine. When visited the first truck-load of ore from the old dump had just been hauled out, and only a few men were working at the mine. Twenty men were working on the old road to get it into shape for the auto trucks. Trucking charge to Crescent City is \$4.00 per ton. Freight rate from Crescent City to Eureka, \$3.50 per ton, with a

wharfage charge at Crescent City of \$1.00. Added to this the cost of transporting the ore to the Eastern markets, it can readily be seen that only under the present war prices can these properties be profitably exploited.

Bibl.: Cal. State Min. Bur., Reports X, p. 167, XII, p. 36, XIII, p. 48, XIV, p. 380; Bull. 38, p. 268.

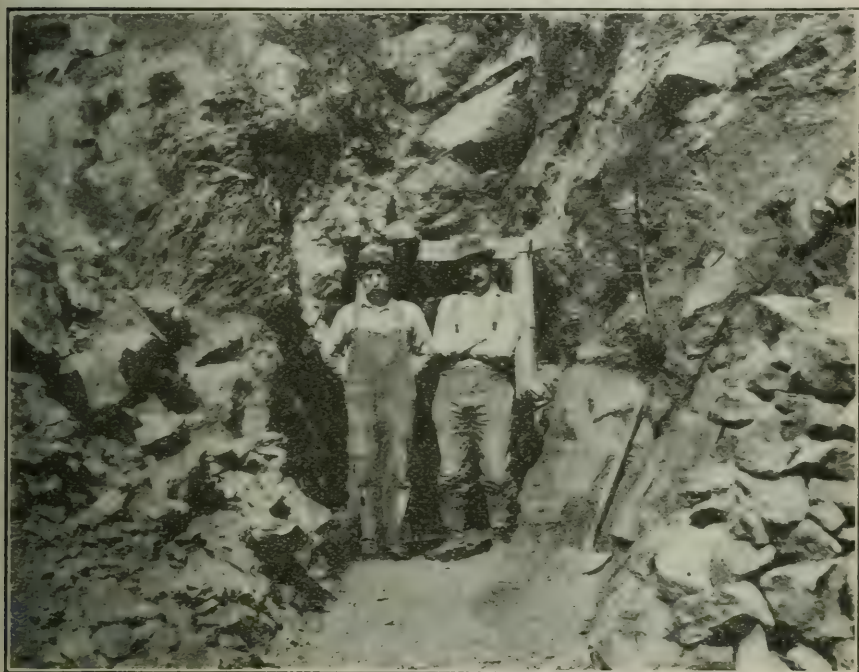


Photo No. 21. Tunnel at Copper Creek Chrome Mine, Del Norte County, 20' below open cut.

French Hill Chrome Mine. It is in Sections 5 and 6, T. 16 N., R. 2 E., about 6 miles in an air line south of the Low Divide mine, and 18 miles by road east of Crescent City. The mine lies on the north slope of French Hill, about 300 ft. below the summit, at an elevation of 1750 ft. above sea level. An old wagon road 3 miles in length gives access to the property from the Crescent City-Grants Pass road. The old road is in fairly good condition and very little work is necessary to prepare it for the auto trucks.

The occurrence here is very similar to that of the Low Divide mine, but the ore is said to carry a higher percentage of chromic oxide, averaging over 50%. In appearance it is the same heavy black, finely crystalline chromite. Development consists of an open cut 30 feet long, exposing an ore body throughout its length that averages 6 ft. in width.

On the dump at this cut are 225 tons of ore, which was mined over 30 years ago by the Tyson Mining Company. Forty feet south of the cut a tunnel recently driven cuts the deposit at 20 ft., showing 6 ft. of ore. Fifty feet below the cut, a kidney, or lens, was also mined by the old company, yielding 150 tons of high grade ore before being exhausted. This ore was never hauled out, so that there were nearly 400 tons of

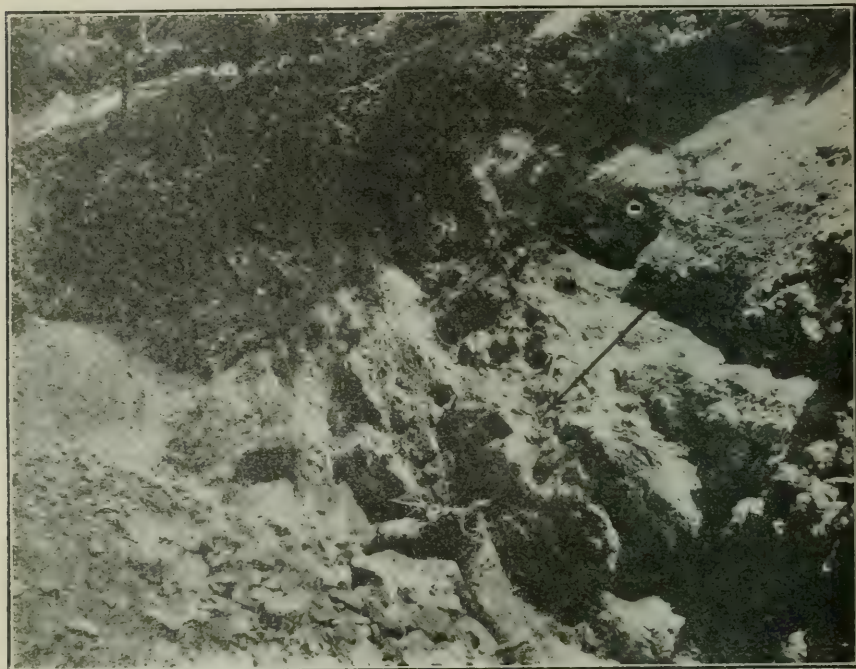


Photo No. 22. Open cut at Tyson Chrome Mine on French Hill, Del Norte County, showing orebody 6' wide.

ore on the various dumps when the mine was taken over in 1917 by the present operators. It was expected to start operations in July and a force of men were repairing the old road so that the ore could be hauled out to Crescent City. R. D. Adams and C. S. Maltby, Humboldt Bank Bldg., San Francisco, are also operating this property under a lease. It is owned by the Tyson Estate, for which W. H. Pleasants of Baltimore is agent.

Bibl.: Cal. State Min. Bur., Reports X, p. 167, XII, p. 36, XIII, p. 48, XIV, p. 380; Bull. 38, p. 268.

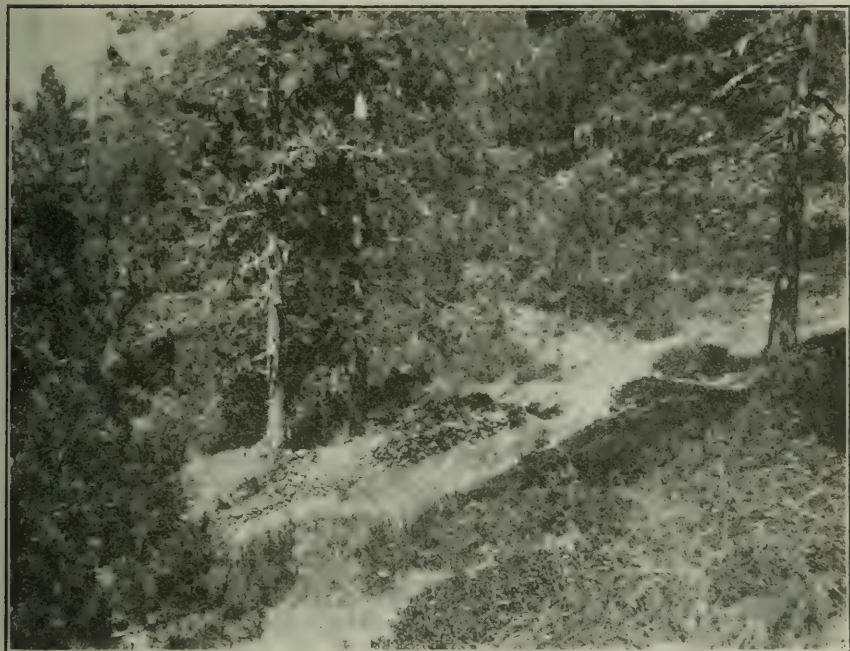


Photo No. 23. Dump containing 150 tons of chromite at Tyson Mine, French Hill, Del Norte County.

Owl Claim. This property located during the past few months, lies along the summit of French Hill, adjoining the French Hill Chrome Mine on the north. The road to the latter traverses the claim. Several small lenses of chromite have been uncovered. They appear to lie on the strike of the French Hill Mine deposit, and may be a continuation of it. Sufficient work has not been done, however, to confirm this opinion. Development work consists of a few small open cuts, and one shaft or pit. The shaft was down 10 ft. exposing an ore body 7 ft. in width. This was the most promising exposure seen on the claim. Three men are employed in the development work. Very little ore is in sight, and none has as yet been shipped. The owners are W. L. Childers, A. Denning, Silas White, et al., of Crescent City.

Chromite also occurs on **Gordon Mountain**, 10 miles east of French Hill, and in the Rattlesnake Mountains. Claims have been taken up at both of these localities, but as they are extremely inaccessible, there is little likelihood of their being developed until there are better transportation facilities.

Between **French Hill** and **Upper Coon Mountain** on the east, and thence to **Madrona** on the south, some fifteen new chromite locations

had been made during the summer of 1917. All these claims lie near the French Hill Cut-off and Gordon Mountain Trails.

In September, 1917, development work had been done only on the claims of **W. W. Young**, where a few men were reported to be prospecting; probably no shipments could be made this season. The properties lie at elevations between 2500 and 4000 feet, three to eighteen miles by trail from the end of the French Hill road at Darnell's mine. A quantity of ore of a fair grade is reported from Young's claims but many of the locations were made on small surface indications which afforded no basis for estimating tonnages.

In September, George Barton and others of Grants Pass, Oregon, were taking bonds on several claims, and were considering the possibility of packing out ore with mules. The locators are Mr. A. W. Lewis, Geo. Rogers, Jack Darnell, Mrs. P. Peacock, Lula Ritter, Melvin Leah, M. Jake, L. L. Lewis, W. W. Young and H. H. Morrell.

The Friday chrome prospect, located by John Hester and H. H. Morrell of Crescent City, lies on the High Plateau in Secs. 21 and 28, T. 18 N., R. 2 E. An outcrop of chromite, six by six feet, was found, but no work had been attempted in September, 1917.

The High Plateau has an elevation of between 2500 and 3500 feet, and pitches sharply on the west into the North Fork of Smith River, which flows in a cañon only 500 feet above sea level. To take out ore from this and the two properties next described, by way of the Smith River road, would require about one and one-quarter miles of tramway, beside a mile or more of trail. Patrick Creek Stage Station lies about twelve miles distant by trail, on the Grants Pass Road.

Hawkins chromite prospect, owned by Wm. Hawkins of Crescent City, lies one mile west of the Friday claim, on the High Plateau. There is an outcrop of good chromite with a maximum width of thirty feet and a length of one hundred feet, but no development had been done to permit an estimate of tonnage. A sample taken is said to have shown 56% Cr_2O_3 . This claim is a mile nearer Smith River and correspondingly farther from the Grants Pass Road, than the last claim mentioned.

High Plateau chrome prospect consists of four claims located in the south half of Section 30, T. 18 N., R. 2 E., and owned by H. H. Morrell and John Hester of Crescent City, who filed locations in the fall of 1917. Claim No. 1 shows soft chromite float for 1000 feet. No. 2 is said to include an outcrop of chromite, ten feet wide over a distance of one hundred twenty feet; and No. 3 an outcrop eight feet wide for a length of forty feet. The owners found these prospects in September, 1917; and had done no mining:

The Smith River road could be reached from these claims by one mile and a quarter of tramway. Ore would have to be hauled twenty miles to reach the terminus of Hobbs Wall Co.'s logging railroad which runs from Crescent City to the logging woods.

The Malpas chrome prospect adjoins the west side of the Tyson property on French Hill. There are four claims located in May, 1917, by H. Malpas, county surveyor of Del Norte County, in company with Messrs. Keller, Chapman and Hotchkiss of Crescent City.

Shortly after location the claims were leased to parties who were expected to do development work and pay a royalty on any ore sold. It is stated that the lessees failed to do any development work and soon after the expiration of their lease, the claims were jumped, on the ground that the original locators had failed to do work showing ore in place. Some forty tons of shipping ore were taken out by the claim jumpers and a deal was made for the sale of it, but when the prospective buyers heard of the dispute regarding title they naturally delayed taking the ore, and further work was halted pending settlement of the dispute. This case illustrates how production from promising properties may be delayed, and loss incurred, by owners and locators due to failure to carry on proper development work.

EL DORADO COUNTY.

The **Austin** mine lies three miles northeast of Georgetown in the SE. $\frac{1}{4}$ of Sec. 25 of T. 13 N., R. 10 E., M. D. M. The property was leased by H. C. Austin from the Southern Pacific Railroad.

Chrome ore occurs as chimneys in serpentine and has been mined by open cuts and shallow shafts. On the east side of the mountain at an elevation of 2900' is a 10' pit, from which about 60 tons of ore were mined and corded. This orebody strikes N. 30° E.

Approximately 60 tons of ore, mainly float, was shipped from diggings on the side hill south of the pit. The ore body had been broken up by erosion and practically all scattered down the hill for a distance of 300'. The original ore body had been open cut from 2' to 3' in depth and 40' long along a direction N. 20° E. Other shallow pits along the crest of the hill have yielded a few tons each.

On the west side of the hill a 16' shaft, with open cut 10' deep and 50' long for drainage, followed a chimney of ore 3' x 7' which pinched in the bottom of the shaft. Seventy tons of ore were mined of which 10 tons remained on the dump.

Over 60 tons of ore were piled by the road near Georgetown where it had been teamed three miles from the mine. The ore was being trucked 19 miles to Placerville. Hauling of the ore from the mine to Placerville costs \$8.00 per ton. Two cars of ore, a total of 93 tons, had been shipped.

The **Bonetti** property includes 20 acres in the S. $\frac{1}{2}$ of Sec. 6, T. 8 N., R. 10 E., M. D. M., four miles east of Latrobe and two and one-half miles southeast of Brandon Station.

Lenses of chrome from 5' to 6' wide occur irregularly, in serpentine, along a north-south strike for a distance of 200'. Development work consists of open cut work 4' deep. Ore mined here by the Union Chrome Company early in 1917 is reported to have assayed from 35 to 45% Cr_2O_3 .

Owned by Chas. and Andre Bonetti of Latrobe.

The **Brandon** property is in Sec. 8, T. 8 N., R. 9 E., M. D. M., four miles east of Latrobe. It is owned by the Messrs. Brandon of Latrobe and was leased to J. Burnett.

Chrome ore was mined by open cut from 4' to 16' deep. The ore body was from 12" to 18" wide and 50' long. The owners believed that they had bottomed the ore and had abandoned the work. Three cars of ore had been shipped and 30 tons of 45% ore were piled near Fionellis siding awaiting shipment.

Buzzard Mill. On the Levy-Darrington Ranch, four miles from Mormon Island (near Folsom) an old 5-stamp quartz mill has been remodeled as a test plant for chromite concentration. An Overstrom Concentrator was put in below the stamps. Power is obtained from two gas engines, one of 30 h. p. and one of 7 h. p. F. Gurney, Box 31, Folsom, is in charge. He plans to erect a new plant nearby.

The **Cassiorni** leases include mining privileges on properties owned by C. F. Irish and the Southern Pacific Railroad in the NW. $\frac{1}{4}$ of Sec. 23, T. 12 N., R. 10 E., M. D. M. The property lies 2 miles south of Georgetown, at an elevation of 2380' on a low ridge.

Lenticular bodies of chrome ore had a strike of N. 30° E. and dip E. 60°. They were being mined by 3 pits, one of which was 6' x 8' x 10' deep, another 4' x 4' x 6' deep, and a third 2' x 6' x 4' deep. The property had been gophered for a distance of 75' and very little ore was in sight.

Operated by Mr. Cassiorni of Richmond, Alameda County.

The **Chaix** chrome properties are in Secs. 12 and 14 of T. 8 N., R. 9 E., M. D. M., about 3 miles east of Latrobe. They include 195 acres in Sec. 12 and 120 acres in Sec. 14.

Lenses of chrome ore in serpentine strike N. 20° E. and dip 70° E. Development work consisted of an open cut 3' to 6' wide, 14' deep and 60' long at an elevation of 830'. Ore is exposed 3' wide, 4' deep and 40' long. About 250' south of the main workings four open cuts had been made 4' deep and 14' long. Five cars of 45 to 48% ore had been shipped from these workings in Section 14.

In section 12 about 20 tons of 43-45% ore had been mined and hauled.

Owned by S. Chaix of Latrobe.

The **Cowell** property in Marble Valley, near Clarksville, is reported to have yielded 4 cars of ore up to December, 1917. It is owned by the Cowell Lime and Cement Company of San Francisco.

The **Donnelly** chrome workings are on a 160-acre lease, by P. Donnelly, Wm. Hathaway, J. C. Adams and G. W. Nielson, of property in Sec. 21, T. 11 N., R. 8 E., M. D. M., belonging to the Southern Pacific Railroad. The workings lie 10 miles northeast of Folsom at an elevation of 1050' \pm .

Lenticular shaped bodies of chrome ore were being mined by 8 men provided with hand tools and windlass. The upper workings at an elevation of 1060' consist of a 20' incline shaft on an ore body which strikes N. 45° E., and dips 45° SE. One foot of clean high grade ore was exposed on the hanging wall and 2' of a low grade mixed ore on the footwall.

An ore body parallel to the first, lies 50' farther down the slope of the hill. It has been cross-cut by two tunnels, one of which is 30' south of the other. The ore is 16" thick where exposed at a depth of 15' below the surface in both tunnels, but narrows to 12" fifty feet farther south.

At an elevation of 1020', farther down the slope of the hill, a 12" vein had been opened up by five 10' pits along a distance of 75' and one incline 16' deep, was equipped with a windlass.

An analysis of the ore taken from the various dumps by the California Ore Purchasing Company is as follows:

Cr ₂ O ₃ -----	46.52%
SiO ₂ -----	6.60%
FeO -----	17.63%
Al ₂ O ₃ -----	11.66%
MgO -----	15.80%
CaO -----	1.23%
Ignition loss -----	0.50%
	99.94%

The **Forni** property lies four miles west of Latrobe in the NW. $\frac{1}{4}$ of T. 8 N., R. 10 E., M. D. M. It was said to be leased to the Union Chrome Company, who intended to develop the prospects.

Owned by J. C. Forni of Latrobe.

The **Freeman** property is in the SE. $\frac{1}{4}$ of Sec. 24, T. 8 N., R. 9 E., M. D. M., about eight miles southeast of Latrobe at an elevation of 590'.

A lens of chrome, in serpentine, striking north-south, and pitching 85° W. was mined by an opencut 2'-3' deep and 30' long. A few tons of ore were shipped. The deposit was small and when the lens narrowed work was abandoned. Owned by Mr. Freeman of Latrobe.

Geisendorfer & Schwartz having opened up chrome properties near Latrobe and Clarksville, were in June, 1918, building a 50-ton concentrating mill at Folsom to treat their low grade ores. The receiving ore-bin has a capacity of 300 tons, and there is an additional 'service bin' of 40 tons. Ore is received by rail and by auto trucks; and after passing through a jaw crusher is raised by a bucket elevator to the service bin, where it is fed to the ball-mill. From the ball-mill the pulp passes to concentrating tables. Water is obtained from the Folsom city mains.

The **Glenn** property adjoins that of P. B. Murphy southeast of Latrobe. It is said to have been prospected for chrome by a 20' open-cut, but the extent of the low grade chrome bearing belt has not been determined.

The property is owned by P. E. and Margaret Glenn of Latrobe, who had leased it to R. Nicol of San Francisco for mining purposes.

The **Green** chrome mine, formerly worked as the Neptune Gold Mine, is in the SE. $\frac{1}{4}$ of Sec. 19, T. 13 N., R. 11 E., M. D. M., 1 $\frac{1}{2}$ miles

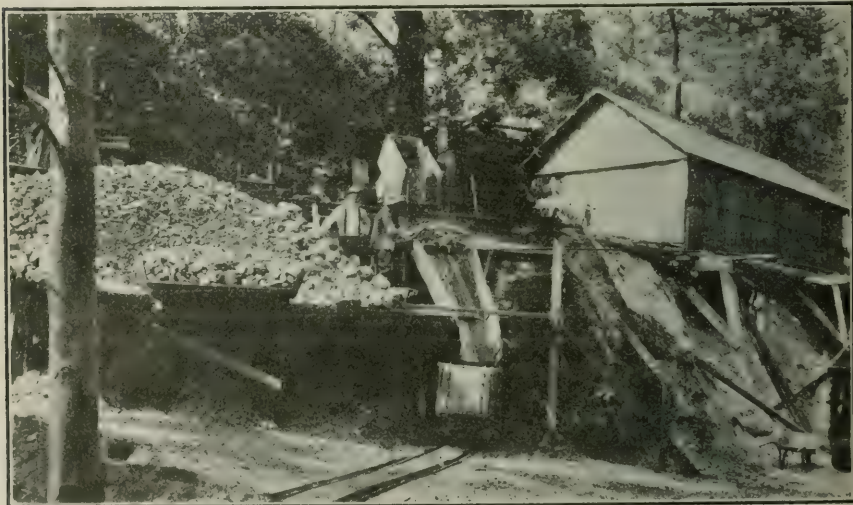


Photo No. 24. Washing chrome ore at Green property, near Volcanoville, El Dorado County.

south of Volcanoville at an elevation of 2730'. The property consists of 8 claims, on Government land, on one of which chrome has been found. It was located by W. C. Green of Georgetown and leased to D. C. Norcross, Secretary of the Western Iron and Fuel Company, 430 California St., San Francisco.

A crosscut tunnel in the old gold mine cut a chimney of chrome ore at a depth of 180' below its outcrop. A 25' winze has been sunk on the ore below the tunnel level. The ore body was 5' x 6' where cut by the tunnel and 2' x 8' in the face of a raise 25' above. The ore appears to be continuous to the surface.

Water power is used to run a ventilator fan for the mine. The property is equipped with a blacksmith shop and mine car. A table is used for washing the ore, which is stored in a bin.

Two men had mined over 100 tons of 45% ore during the month ending June 13, 1917. Of this 50 tons were stored in the mine, and about 60 tons were in the ore bin ready to haul. The ore was to be hauled 37 miles to Auburn, costing about 30¢ per ton mile. One-half mile of new road had recently been built to the property.

The **Hoff** property is in Sec. 30 of T. 8 N., R. 10 E., M. D. M., five miles southeast of Latrobe at an elevation of 635'. It includes two claims owned by Jas. O'Brien, Peter Hoff and Chas. Ybright.

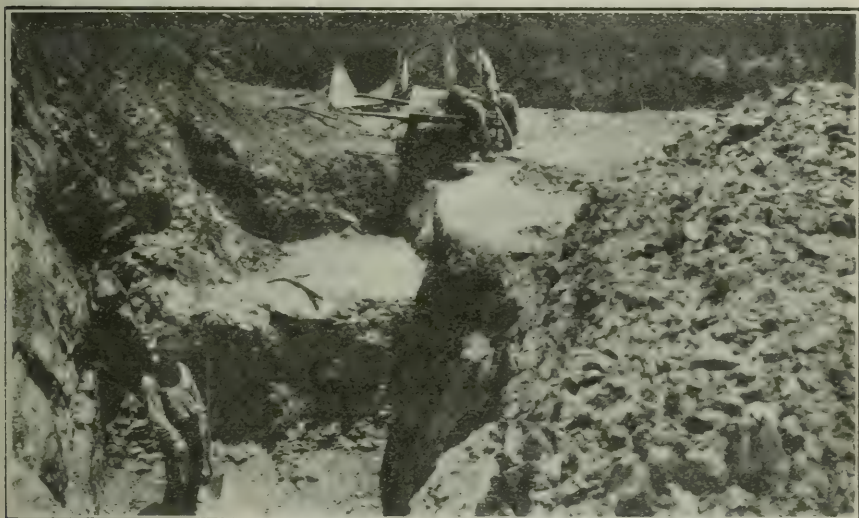


Photo No. 25. Alpine Chrome Claim, of Hoff Group, El Dorado County, showing width of vein, and ore pile at right.

A lens of chrome ore on the Alpine claim strikes east-west and the west end swings N. 60° W. The ore body is 10' wide in the center, and 56' long, tapering at both ends. There appeared to be about 233 tons of 33% ore in sight.

An ore body on the Cosumnes claim has been developed by a 10' open cut on a side hill from which one-half car of ore had been shipped. Some ore still remained to be worked.

Approximately 150 tons of ore had been, or was being, shipped up to June 1, 1917. The ore was said to have been sold to the Union Chrome Company of San Francisco, and to average 33% Cr_2O_3 .

The **Irish** ranch is five miles southwest of Cummings in Secs. 7 and 8 of T. 9 N., R. 10 E., M. D. M. Chrome ore, striking north-south, has been developed by two 20' pits. Three cars of 35% ore were mined and shipped from Cummings in 1917 by the American Refractories Company.

The **Joerger** property is in Sec. 35, T. 10 N., R. 8 E., M. D. M., $1\frac{1}{2}$ miles northwest of Clarksville at an elevation of 990'. It is owned by Ella M. Joerger of 5808 Ocean View Drive, Oakland, and leased to Bert Fitch, John C. Evans and George Rickard of Clarksville.

A lenticular body of chrome ore in serpentine was exposed, striking N. 30° W. and dipping east 68°. It had been open cut from 4' to 8' deep and 110' long, being 12' wide near the top. The ore body had pinched in the bottom of the workings and the lessees did not intend to go much deeper, although another ore body could probably be found. It was reported, in December, 1917, that work had been carried to a depth of 48 feet on good ore.

The lessees shipped 47 tons of 38% ore to the American Refractories Company and had about 40 tons of ore on the dump in June, 1917.

The **Kelly** property is in the NE. $\frac{1}{4}$ of Sec. 16, T. 11 N., R. 8 E., M. D. M., near Rattlesnake Bar, 6 miles southeast of Newcastle, at an elevation of 560'. It is owned by M. A. Kelly of Auburn.

Chromic oxide occurs disseminated throughout a siliceous serpentinized rock. About 25 tons of 28% ore have been mined by two pits, one 5' x 12' x 10' deep and another 3' x 5' x 4' deep. There appeared to be about 12 tons of a similar ore in sight. It was said that another prospect on a hill north of these workings might yield ore of a higher grade.

The **McCurdy** property is in the NW. $\frac{1}{4}$ of Sec. 8, T. 11 N., R. 10 E., M. D. M., 2 miles north of Coloma at an elevation of 1900'. It is owned by Mr. McCurdy of Garden Valley and leased to F. A. Cassiorni of Georgetown and P. Michelsen.

Lenticular bodies of chrome ore striking N. 10° E. and pitching 80° E., had been developed. A lens of ore 18" wide and 10' long was exposed by an open cut 30' long. Southwest of this a body of low grade ore was exposed by a 20' open cut. To the north, a pit 8' deep exposes high grade ore, of which 25 tons of 45% ore had been mined and was in a pile.

The **Murphy** property is in the SE. $\frac{1}{4}$ of Sec. 14, T. 8 N., R. 9 E., M. D. M., 2 miles southeast of Latrobe. Chrome occurs on a 160 acre portion of a 420 acre patent owned by P. B. Murphy, Mrs. T. P. Mur-

phy and daughters. The mineral rights had been bonded to R. Nicol of San Francisco, in May 1917, and work was to be commenced in 60 days.

A belt of low grade chrome-bearing serpentine has a N. 20° E. direction. It had been prospected by shallow trenches across the center and two ends. The material as exposed is of low grade down to 6' in depth, with stringers, up to 12" in width, of a higher grade ore running up into it. The deposit is about 27' wide across the center and 200' long and there should be approximately 2250 tons of workable material of over 20% Cr₂O₃ down to a depth of 20 feet, allowing for lenticularity.

At **Nigger Hill**, on the Burnett ranch, the Noble Electric Steel Company has recently completed a chromite concentrating plant. From a Blake crusher the ore goes to a 50-ton ball mill fitted with continuous screen of 12 mesh. The pulp goes without classification to two Wilfley tables, then to a Senn concentrator. This plant has just been put in operation (May, 1918), so no opinion can be expressed as to its success or to run of ore and concentrate. If performance comes up to present expectations, the plant will probably be enlarged to handle 150 tons daily.¹

The **Ogle** property is in the NE. $\frac{1}{4}$ of Sec. 18, T. 13 N., R. 11 E., M. D. M., one mile south of Volcanoville at an elevation of 3100'. It is owned by E. C. and W. H. Ogle of Volcanoville, and was worked in May, 1917, by the Union Chrome Company of San Francisco, whose lease has since expired.

Chrome lenses striking north-south in serpentine had been open cut to a depth of approximately 20', irregularly, for a distance of 75'. About 47 tons of 45% ore were shipped from Auburn, a distance of 36 miles. Hauling is said to have cost 30 cents per ton mile.

The **Pilliken** property is in Sec. 28, T. 11 N., R. 8 E., M. D. M., of the Salmon Falls district. It lies nine miles northeast of Folsom at elevations ranging from 800' to 1200'. It will be noted that barometric elevations given here do not correspond with those given for this property in our report on Sacramento County; those given here are believed to be more nearly correct since the others were taken during a threatening storm. The chrome deposits are owned by Geo. Pilliken and others of Folsom, but leased to the Noble Electric Steel Company of 995 Market St., San Francisco.

Chimneys and lenses of chrome ore in serpentine have been developed by open cuts, incline shafts and tunnels as follows:

The No. 1 or lower workings are in the NE. corner of the NW. $\frac{1}{4}$ of Sec. 28. An orebody striking N. 25 W. has been developed by a 150'

¹A new mill of sturdier construction is being installed here and production is delayed.

tunnel running N. 30° E. Eighty feet from the tunnel entrance a 30' raise extends to the surface and the ore appeared to have been mined out; this orebody struck east-west and pitched 40° N. and was followed downward by an incline to a depth of 70', below the tunnel level, where ore is exposed 2' wide along 12' of the lower workings; this incline is 20' east of the tunnel and 90' from its entrance, being connected with it by drift.

In the face of the 150' tunnel, at a distance of 80' from the first, is a second parallel ore shoot followed by a 70' raise to the surface; 30' from the surface two 10' drifts have followed the ore for 30' east and west. The ore exposed is somewhat mixed with serpentine, but is from 2' to 4' wide and averages 40% Cr₂O₃. This same orebody has been



Photo No. 26. Chrome mines on the Pilliken property, El Dorado County.

followed by open cut on the surface, at an elevation of 840' from 3' to 8' deep; the ore exposed is from 2' to 3' wide and somewhat mixed with serpentine and granular ore. A 10' shaft from this level shows a good lenticular shaped orebody opening up from 6" wide at the tunnel level to 5' in the bottom of the shaft. This ore will probably be worked by a raise from the lower tunnel.

At an elevation of 860', 75' northwest of the last described workings, a 50' tunnel has been run due north cutting a body of chrome, striking N. 10° W., and pitching east 45°. The orebody exposed is 12" wide and consists of a high grade ore mixed somewhat with serpentine and tremolite. In the face of the tunnel the ore is exposed 12" wide for 6' across the face and 24' along the floor of the tunnel. Ore is also exposed 2' wide in a 35' up-raise to the surface on the southeast side of the tunnel; this orebody is offset from the one exposed near the surface. There was 10 tons of ore on the dump.

To the northeast the old upper workings or glory-hole appeared to be about cleaned out, except for a few small stringers which are being prospected to the northeastward. Below this at an elevation of 900' a 50' open cut has been run into the hill along a direction N. 20° E., opening up some mixed ore in the face, which is 20' high. This has been mined by a 50' east-west cross-cut, 10' from the entrance of which a cross-stringer was being followed, by a drift; this 16-foot west drift had exposed ore 12" wide for a distance of 5' along the face. The same orebody extends eastward, towards the old workings, but has not been developed. It has promise of widening out with depth. About 25 tons of ore were on the dump.

At an elevation of 885' about 150' south of the old glory-hole workings a large body of 40-45% ore has been exposed. The orebody strikes N. 40° W. and has been stoped for a distance of 50' following chimneys of ore to the surface. The ore is worked through a tunnel below.

A 50' incline with entrance at an elevation of 875' follows an orebody which showed a 12' face in November, 1916. These workings have now been extended 10' deeper and chrome ore is exposed 15' thick and 20' wide with no indication of pinching. The footwall strikes east-west.

West of the above described orebody is an ore-shoot striking N. 80° E., and pitching 55° NW. The main working tunnel cuts the ore near its entrance where a 12" vein is exposed. It widens to the northeast and has been followed down 40' by an incline, at the face of which 2' to 3' of ore is exposed. The ore is also cut at a distance of 40' farther north, by a 20' tunnel, and has been followed down by a 25' incline. The ore between these two tunnels has been stoped to the surface, but is blocked out below and the ore would average about 38% Cr₂O₃.

South of the main working tunnel (Elev. 860') an incline has followed this same orebody down to 50' below the surface. The orebody mined was 20' thick and 30' long and 1' of ore was left exposed on the hanging wall. Ore exposed on the south face averaged 2' wide and 20' long. The lens strikes N.-S. with a dip of 20° E. and it appears as though it might make an ore-shoot to the south.

The No. 2 developments are on the south side of the hill, one-half mile southeast of No. 1, where some old workings are being opened up. At an elevation of 830' a 30' shaft was sunk on a N.-S. orebody, pitching 40° E. The orebody averages 4' thick in the bottom, the greatest width being 10' at the center; it tapers to 1' wide in 16' down the pitch to the east. About 15 tons of 40% granular ore had been taken out in the last two weeks of May, 1917. A 2' stringer to the east is going to be opened by a new shaft; old workings were carried only to the water level. At an elevation of 840' about 500' east of the new 30' shaft is an old 20' shaft sunk in the early days; ore exposed in the bottom is said to be 3' thick and 12' long, striking N.-S. and pitching east 35°.

No. 3 workings lie at an elevation of 995' on the upper slope of the hill, approximately one-half a mile due north of No. 2 workings. An old open cut 10' deep has followed a body of chrome ore for 90' along its strike. The orebody pitched 68° east and was partially worked by a tunnel. About 3' of mixed ore was being opened up in the hanging wall near the center of the old workings and one ton of 45% ore was on the dump. If the main orebody has not already been worked, by tunnel on the lower level, probably considerable ore remains. This same orebody has been opened up by an old 20' tunnel for a distance of 30' and has been traced by two open cuts for 30' farther northward.

No. 4 workings are about 500' south of No. 3 at an elevation of 950'. An 80' incline has followed an orebody striking N. 35° W. The lens is 4' wide in the center and 20' long, tapering irregularly to 10" in width at each end. About 275 tons of ore averaging 43% Cr₂O₃ had been taken out. A 16' incline shaft to the north had followed an orebody 1' thick and 8' long; a stringer was followed eastward for 25' where another orebody of considerable promise was being opened up.

No. 5 workings consist of an old 16' incline shaft, in a ravine, 200' east of No. 4. It follows a body of leopard chrome which is exposed on both sides of the shaft. This was not being worked. In the saddle of the hill about 500' southwest of No. 4 is a prospect of leopard chrome as yet undeveloped.

The ore is hauled nine miles to Folsom in 2½-ton motor trucks for \$2.50 per ton. Approximately 3750 tons of ore had been produced by the property up to June 6, 1917. Eleven cars per month were being shipped and 30 men were employed. The last seven cars shipped each carried over 46 tons of ore averaging over 43% Cr₂O₃ and 7% SiO₂. The concentrating plant here will be enlarged by adding two units, giving a total capacity of 150 tons of ore daily. Water for milling will be taken from American River.

The **Pfeiffer** property is in the N. ½ of Sec. 13, T. 8 N., R. 9 E., M. D. M., three miles east of Latrobe at an elevation of 500'. It is owned by Wm. Pfeiffer of Latrobe, and leased to the Union Chrome Company of San Francisco.

A lens of chrome was exposed, striking N. 30° E. and pitching 85° S.E., in serpentine. It was developed by an open cut 3' to 6' wide, 6' to 10' deep and 30' long. About 30 tons of ore had been shipped and there were 50 tons on the dump.

The **Pilot Hill** property is in the S. ½ of Sec. 6, T. 11 N., R. 9 E., M. D. M., nine miles southeast of Auburn, Placer County. It is owned by John Revoir and Frank Costa of Pilot Hill and had been leased to the Union Chrome Company of San Francisco. The lessees are reported

to have shipped about 200 tons of ore from the property in 1916. The development work was shallow.

The **Placer Chrome Company** own or lease properties in Secs. 15, 16, 21 and 22 of T. 11 N., R. 8 E., M. D. M., 8 miles southeast of Newcastle, Placer County. Those interested are R. H. Farmer of Newcastle, superintendent and general manager; W. P. Netherton, treasurer; and Stanley Swanton. The holdings include 950 acres purchased from the Holmes Lime Company; a 1600 acre lease from the Zantgraff Gold Mining Company; a 2880 acre lease of the Steele property; a 1500-1600 acre lease from Lovejoy and Stevens, and 160 acres of railroad land in Section 21.

Lenticular shaped bodies of chrome ore occurring irregularly in serpentine have been opened up by tunnels, shafts and open cuts. On the south side of Granite Ravine a 45' shaft has followed a N.-S. vein, which has been stoped for 40'. The ore is exposed 3' wide in the bottom of the workings and in the south face where it appears to extend for from 10' to 20' farther south as indicated on the surface.

On the north side of the Granite Ravine, on the southwestern portion of a ridge, elevation 1000', is a shaft 16' deep with a 14' drift to the north. The ore shoot struck N. 20° W., and pitched 35° E. The ore appeared to have pinched, but may open up with deeper work. Four tons of 30% ore were on the dump. A tunnel 150' farther south followed a stringer of chrome ore for 60', but it pinched out.

At a distance of 75' northwest a pit 20' deep and 10' in diameter carried low grade ore, but it was not being worked. Shallow pits have followed this low grade ore for 100' farther north. Approximately 100' northeast a 20' incline was run southwest in ore averaging 38%; the ore body is banded and granular and strikes N. 30° W. with a pitch 40° SW.

On the east slope of this same ridge in a direction N. 25° E. from the incline last mentioned, is a stope 5' x 26' following an ore body striking N. 30° W. and pitching 70° SW. The ore consisted of 3' or more of chromite mixed with more or less serpentine. Eight tons of ore were in a pile. Approximately 30' SE. of the latter stope is another following an ore body, 3' wide, for 16' along the strike; it is 50' deep and has been stoped for a distance of 30' in the lower 28'. The ore averages 28" wide in both the north and south faces and is exposed at both ends along the lower 20'. The ore shoot appears to persist in the bottom of the workings. Equipment consisted of a windlass. Six tons of ore were in the pile.

On the west slope of the same ridge, at an elevation of 980', the northernmost workings consisted of a 30' stope along a NS. ore body which occurred in irregular kidneys. A 26' open cut led from a wind-

lass to the ore pile where 25 tons of 38% ore were corded. Approximately 40' south of this a similar open cut and stope had developed similar ore and 25 tons were corded. About 60' south of the last workings a 30' open cut led to two 20' drifts, north and south, which followed an ore body. In the south face of the south drift the ore was lenticular, being 4' high and 4' wide at the bottom. The ore was granular and mixed with serpentine. In the north drift the ore was similarly streaked and granular and the face showed ore 6' high and 3' wide, which averaged about 38% Cr_2O_3 .



Photo No. 27. Chromite concentrating mill of Placer Chrome Company at Rattlesnake Bar, El Dorado County, June 4, 1918, after enlargement.

Equipment at the mines consists of hand tools and windlass. An 1890' gravity tramway was installed in September, 1917, for lowering the ore to two 50 ton ore bins. Ore averaging 35% or over is trucked direct to Newcastle for shipment, while the lower grade is trucked a mile and a quarter to a concentration mill, near Rattlesnake Bar.

The mill consists of a 3'x6' grizzly, 8"x12" Blake crusher, Hendy self-feeder and 4'x5' ball mill, 2 Deister-Overstrom concentrators and 1 Deister-Simplex sand concentrator. The crusher and mill are run by a 20 h.p. Fairbanks-Morse engine, while the tables are driven by a 4 h.p. gas engine. Water for the mill is pumped from the American

River, near Rattlesnake bridge, by a 6 h.p. gas engine. The plant cost in the neighborhood of \$18,000.¹

The ore being tested by the plant averaged about 20% Cr_2O_3 and a concentrate better than 40% was being produced, leaving 10% in the tailings. Probably a 50% concentrate and a cleaner discard will be made as the adjustment of the various units of the plant becomes more perfect.

Forty-two men were employed, including those at the mill, the last of September, 1917. About 6 carloads of crude ore per month were being shipped. The mill had not yet been placed on a producing basis.

The **Schelly** property is in the NE. $\frac{1}{4}$ of Sec. 5, T. 11 N., R. 10 E., M. D. M., two miles north of Coloma at an elevation of 1880'. It is owned by L. M. Schelly, assistant district attorney, Sacramento.

A lenticular body of black siliceous, low grade chrome ore strikes N. 20° E. It had been open cut for a width of 16' and a length of 40'.

Considerable ore had been mined and hauled by the Union Chrome Company of San Francisco, but the property was idle when visited. It was said that parties had a contract to mine a body of ore which was exposed and held some promise.

The **Simpson** ranch includes some chrome deposits in Sec. 13, T. 10 N., R. 8 E., M. D. M., 9 miles east of Folsom at an elevation of 850'. The deposits are leased on royalty basis by F. Fleishbein and L. Kinney of Folsom.

Lenticular bodies of chrome ore occur, along a contact of serpentine and schist, striking NS. and dipping 55° E. An ore body being worked was 28" wide, 16' long and 20' deep with ore exposed in the bottom. A 12" body of ore had been traced by shallow shafts for a distance of 75' northward and 200' southward. About 35 tons of 35% ore had been mined and corded for shipment.

W. L. Stifle has done some shallow surface work in the SE. $\frac{1}{4}$ of Sec. 23, T. 12 N., R. 10 E., M. D. M., about 1 mile southeast of the Cassiorni lease, and 3 miles south of Georgetown. About 4 tons of 35% ore had been corded for shipment.

The **Tropper** ranch chrome deposits are in the NE. $\frac{1}{4}$ of Sec. 32, T. 12 N., R. 10 E., M. D. M., $1\frac{1}{2}$ miles west of Garden Valley at an elevation of 1950'. Two claims were located by Dave Shepard on the homestead of Frank Tropper of Greenwood. They had been leased to the Union Chrome Company of San Francisco, who are reported to have shipped 110 tons of ore.

¹Since the above was written the capacity of this plant has been doubled to 100 tons per day (see Photo No. 27), by the addition of a gyratory crusher, rolls, another ball-mill, and 5 'Overstrom Mineral Concentrators' (a new table, built by the Hedy Iron Works). A Frenier sand-dump elevates the middlings for re-treatment. Electric power is used.

A 40' incline shaft exposed 3' of ore in the hanging wall along the lower 30'. The lens is probably 10' long and pinches at either end. A 16' vertical shaft with a 12' incline, 14' south of the first, shows no ore, but the lens mined appeared to have pitched 50° to the east.

The **Wiley** property consists of a 220-acre patent in Secs 1 and 10, and a lease on a location in Sec 11 of T. 10 N., R. 9 E., M. D. M. It is owned by D. E. Wiley of Folsom and leased to Mr. Gill and others who were prospecting with open cuts and pits. Three men were working in June, 1917, and 15 tons of 45% ore are said to have been mined from Sec. 1 and sold.

Zanini Bros. of Latrobe, have a deposit of low grade chrome on their property in the W. $\frac{1}{2}$ of Sec. 35, T. 9 N., R. 9 E., M. D. M. A 20' shaft had been sunk, but the ore was of too low grade to ship.

FRESNO COUNTY.

The **Carson** and **Sweet** prospect is near Watts Valley on property owned by Mr. Hyde of the Visalia Bank. It is leased by Frank Carson of the Visalia Land and Investment Company. Two promising chrome ore bodies are reported to have been found, and development work was to be started. The same party is reported to have chrome bearing properties in the Pine Flat district.

The **Franks** property is in the Pine Flat district in Sec. 25, T. 12 S., R. 24 E., M. D. M., 6 miles northeast of Piedra. The workings are on the slope of a hill on the property of J. R. Franks of Piedra.

An irregular body of chrome ore 2' thick occurs in serpentine. The ore was being mined by J. Rice who paid 50 cents per ton for sledding of the ore down the hill and \$2.50 per ton for hauling it to Piedra. The ore was being sold for \$13 per ton, loaded on the car at Piedra.

Messrs. Woods, Blazel and McGee are said to have shipped 4 cars of ore from the Pine Flat district in 1916.

The **Mineral Resources Corporation of America**, Ralph E. Hyatt, president, Hughes Hotel, Fresno, hold the Lacy property in Sec. 19, T. 11 S., R. 24 E., M. D. M. It was leased by the Union Chrome Company of San Francisco until February, 1917.

Chimneys of chrome ore have been mined by open cuts and pits, and it is reported that 500 tons were shipped in March and 200 tons in April. Eight men were employed in May, four of whom were driving a tunnel 200' long with the idea of cutting ore at a depth of 100' below the surface.

The **Rhodes**, **Byles** and **Gribble** mining property is near Condon Peak, at an elevation of 4500', in the SE. corner of Sec. 35, T. 18 S., R. 12 E., M. D. M., about 28 miles northwest of Coalinga. It consists of 1 claim

on the property of the Aurora Quicksilver Company, leased by L. H. Rhodes, C. N. Gribble and Mr. Byles of Coalinga.

Chromite occurs as shoots and nodules in greenish white serpentine. The ore varies from small high grade bodies running 45% and over to low grade disseminated, granular deposits. A large tonnage of ore should be available, but the mining cost will be high on account of the scattered character of the ore.

The deposits had been open cut, by hand labor, on the slopes of a ridge. The ore is hoisted to the top of the ridge in a one-ton car by a distillate engine. Approximately 20 tons of ore were taken from one ore body and a total of 90 tons had been shipped from the property up to May, 1917. It is reported that the costs of mining and hauling to Coalinga were high and that the early shipments being poorly sorted did not pay expenses.

The **Snyder** property, in the Pine Flat District, is reported to have yielded 10 tons of float chrome which had been sledded down to Hughes Creek, but not shipped as yet. Owned by R. S. Snyder of Piedra.

The **Watts Valley** region had yielded nearly 3000 tons of high grade chrome ore, up to May 4, 1917, under the development carried on by the Union Chrome Company of San Francisco. The properties lie mostly in Sec. 19, T. 11 S., R. 24 E., M. D. M.

The *Clara H.* patent is owned by Messrs. Spear and Laffinger of San Francisco. It had been developed by a 100' shaft, and a chimney of ore 6' x 10' had been mined out to within 15' of the surface. Considerable open cut work had been done on the surface adjoining the shaft. At least 75 tons of ore unmined were exposed by the deeper workings.

The *Camden* claim is on government land developed by open cut 3' wide and 20' long along the ore body. The depth of the ore could not be determined, but at least 50 tons were in sight.

The *Rock Wren* claim is on government land. It was being worked by contract for \$4.00 per ton for ore carrying 30-35% Cr_2O_3 and \$15 per ton for ore of 35% and over. The ore body was 2' wide and from 50' to 60' long, and at least 83 tons of chromite were in sight.

The *Second Thought* claim is on government land. About 10 tons of ore were exposed by a body 20' wide, 10' long and 4' deep.

When visited in May, 1917, thirteen miners were employed at \$3.25 per day. About one ton per man was being taken out each day. Hauling to Clovis from the Clara H. patent cost \$5.50 per ton, while hauling from the Rock Wren claim cost \$4.00 per ton with 75 cents per ton for sledding.

New Mills. Since the field work for this report was completed, we have been advised of plans for the early construction of three chromite concentrating plants. These will be built by C. E. McBride of Sanger, L. R. Payne, Associated Warehouse, Fresno, and C. S. Snow, Academy.

GLENN COUNTY.

Deposits of chromite occur in the serpentine belt which follows the eastern slope of the Coast Range Mountains, down through Tehama, Glenn, Lake and Napa counties. All of the chrome produced in Glenn County was mined from the Black Diamond Group described below. Other deposits have been located, but they have as yet yielded no commercial output. Prospecting for chromite will undoubtedly disclose other bodies, as the soil in the water courses of the serpentine areas often contains considerable chromite. The belt in which the serpentine occurs is rather rugged and covered with shrubbery, so that prospecting is difficult.

The **Black Diamond Group**, comprising 14 mineral claims, is in Section 25, T. 22 N., R. 7 W., 18 miles by road northwest of Fruto, the shipping point. The deposits lie near the summit of Red Hill, over 1000 ft. in elevation above the bunkers at the foot of the mountain. Chrome ore was first mined here by J. R. Whitlock and F. Oakes, during the early nineties, and up to 1894 over 3000 tons were shipped out. The property then lay idle until it was taken over by the present owners in 1916. It was worked part of that year and late in the fall all operations ceased. It is again idle.

The deposits occur in the form of large irregular lenses in serpentine, the chromite often being so intermixed with the country rock that there is no sharp line of demarcation between them. The limits of the ore bodies are determinable solely by their commercial value. Five different deposits have thus far been developed, the richer parts having been exhausted. There now remains considerable ore which probably contains less than 30% chromic oxide, in the several irregular open cuts or quarries. The largest body of chromite now exposed is on the Black Diamond claim. Small crystals of chromite are irregularly disseminated throughout the walls of an open cut, whose face is 25 to 40 ft. high and about 60 ft. across. It is absolutely impossible to determine the amount of this ore available, as there has been no further development. Undoubtedly sufficient tonnages could be developed to warrant concentration of the low grade ore, which would increase its value and make it easily marketable. Water for milling purposes would have to be brought in from the valley below, as there are only a couple of small springs on the claims.

The ore was hauled down the mountain side by trams, as the grades are too heavy for the operation of motor trucks. It was dumped into bunkers below and there loaded into the trucks for the haul to Fruto. The old wagon road about two miles up the mountain side has been washed out and would practically have to be rebuilt before any hauling could be done over it. Owner, California Chrome Company, Kohl Bldg., San Francisco; J. B. Huffard is president.

Bibl.: Repts. XII, p. 36; XIV, p. 194; Bull. 38, p. 268.



Photo No. 28. Black Diamond Chrome Mine, Glenn County, being worked by the California Chrome Company.

Conklin and Williams Claims. Wells Conklin and Ed Williams of Newville, Cal., located two claims in Sec. 3, T. 22 N., R. 7 W., 30 miles west of Orland. There is a good auto road to the Conklin Ranch house, two miles from the claims, which are reached over a poor trail. The chromite occurs as small bunches or lenses in the serpentinite. On the Salt Creek claim, a small open cut 4 ft. across exposes an orebody 2 ft. in width. About one ton of ore is lying on the dump. At the Twin Rock Claim, three-fourths of a mile north of the former, six small lenses were mined yielding about 100 tons of high grade ore. It is lying on the various dumps. J. A. Heslewood of Oakland, has a lease on these claims but they were not being worked when visited and no ore had been shipped.

HUMBOLDT COUNTY.

Horse Mountain Copper Mine. Since the closing of the field work for this bulletin, reports state that a deposit of chromite has been opened up in the serpentine area on the property of the Horse Mountain Copper Company, about 25 miles N. of E. from Eureka; and that shipments of ore are being made.

LAKE COUNTY.

The occurrence of chromite in Lake County was known previous to 1888* but the deposits up to within the last few years were of no particular commercial importance, due to their great distance from shipping points. Lake County is not traversed by a railroad, so that all freight to or from the county is hauled by teams or motor trucks from points in the Napa Valley, or from stations along the Northwestern Pacific Railroad in Mendocino County. This necessarily makes freight rates high and the deposits could only be worked under the most advantageous market conditions.

Commercial production started in 1916, and the county is at present an important producer. Production was stimulated by the Sawyer Tanning Company, who having a plant at tidewater at Napa, use the chromite for acid compounds in tanning purposes. Practically all of the chromite now mined in the county is shipped to the tannery at Napa, the Sawyer Tanning Company, itself, mining under leases most of the deposits.

The chromite occurs as lenses of hard black ore, containing little or no serpentine and having a sharp contact with the surrounding serpentine. It is high grade, usually averaging over 45% chromic oxide. The lenses vary in size from small pockets to bodies of several hundred tons. Of the latter, however, only two have thus far been uncovered. As the serpentine areas are very extensive throughout the county, further prospecting will undoubtedly reveal others.

Arthur Copsey et al., of Middletown, recently located three claims in the southwest quarter of Sec. 33, T. 12 N., R. 7 W., 23 miles north of Calistoga, the nearest railroad station, and eight miles east of Middletown. The chromite here occurs in the decomposed serpentine along the top of a ridge, as small stringers varying from 2" to 1' in width. The general trend of these stringers is north and south, and they appear to be entirely superficial. Chromite sand is very abundant in the soil capping over the ridge, particularly in the water courses, due to the disintegration and washing away of the weathered serpentine, but no large deposits have been found. The owners are mining the few small deposits by shallow trenches, and have about 25 tons of ore on the

*Cal. State Min. Bur., Report VIII, p. 326.

various dumps. This will have to be sledded about one-quarter of a mile to the old wagon road, whence it can be hauled by team to Calistoga. No ore has, as yet, been shipped.

Fuqua and Bell Mine. See **Lucky Strike Mine.**

Great Western Mine. A deposit of chromite is being developed at this property which for many years was a large producer of quicksilver. It is in Sec. 16, T. 10 N., R. 7 W., 16 miles by road north of Calistoga. The orebody occurs in decomposed serpentine on the steep slopes of a ridge at an elevation of 2350 ft., and several hundred feet above the old quicksilver mine workings. It is in the form of an irregular lens of black chromite, very much fractured, and it breaks readily, being easily mined by pick and shovel. In the face of the open cut, by which it is being excavated, was exposed from 3 to 5 ft. of ore, over a length of 15 feet, striking east and west. At the east end it divides into three parallel stringers, each about one foot wide. These have been followed for 50 ft. along their strike. There is a very heavy overburden here and as the slope of the hill is over 45° , it is rapidly becoming heavier, so that, for every ton of ore excavated, ten tons or more of dirt have to be moved. Tunneling is impossible, as the country rock is soft and decomposed that heavy timbering would be necessary, and there is not sufficient ore exposed to warrant such expense.

To date about 125 tons of ore have been shipped to the Sawyer Tanning Company. It averaged from 45% to 50% chromic oxide. The ore is hauled by six-horse teams to Calistoga at a cost of \$5.00 per ton. Four men are employed. Henry Tucker et al., of Calistoga, started operations in January, 1917, under lease from the owners, Newhall Estate of San Francisco.

Harp and Sons Ranch. The Sawyer Tanning Company have developed several rich pockets of chromite on this property, which is in Section 20, T. 11 N., R. 7 W., 3 miles northwest of Middletown on the Harbin Springs road. Fifty tons of ore, which is reported to have run from 50% to 52% chromic oxide, were recently mined in open cuts from a few lenses which have been exhausted. The company is prospecting in the serpentine areas for other deposits. H. W. Westendorf is in charge of the mining operations for the company.

Lucky Strike Mine. It is in Morgan Valley, in Section 24, T. 12 N., R. 6 W., 60 miles by road north of Napa, at an elevation of about 2800 ft. above sea level. The deposit was located in 1916, by T. F. Fuqua and R. E. Bell of Lower Lake, and 450 tons of high grade chromite was hauled out to the Sawyer Tanning Company's plant that year. In April, 1917, it was taken under lease by the above mentioned company, who, up to date, have produced over 700 tons of ore which is said

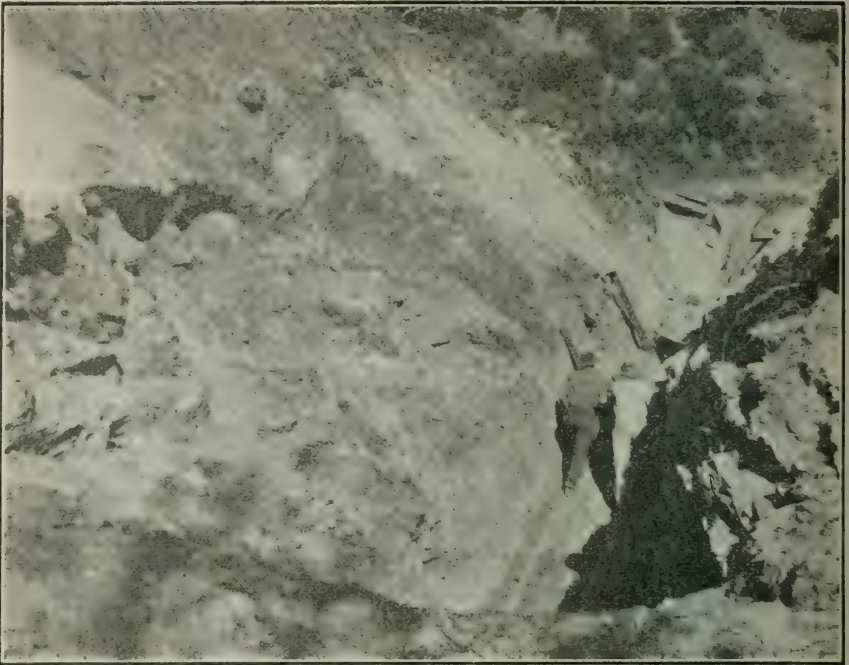


Photo No. 29. Open cut at Lucky Strike (Fuqua and Bell) Chrome Mine, Lake County.



Photo No. 30. Ore ready for shipment at Fuqua and Bell Chrome Mine, Lake County.

to average over 45% chromic oxide. The greater portion of this was mined in a large cut from one body. The cut is 60 ft. long, and the deposit varied up to 8 ft. in width. When visited, it had almost been exhausted, as there was little ore remaining exposed in that working. Several smaller kidneys are being developed, and there are numerous small boulders of the chromite lying in the soft soil over the property, which embraces three mineral claims. About 200 tons of ore were piled at the platform below the mine ready to be shipped.

The ore is hauled down the mountainside about $\frac{1}{4}$ mile by teams to a loading platform, whence it is loaded into auto trucks and hauled to Napa at a cost of \$8.00 per ton. Ten men are employed. H. W. Westendorf is Superintendent.

LOS ANGELES COUNTY.

Chromite is but little known in Los Angeles County. Only two occurrences have been reported; one of which is one mile west of Harold Station on the Southern Pacific Railroad, in T. 5 N., R. 11 W., S. B. B. & M. The owner of one claim located on the deposit is Nick Evert, 1027 W. Sixteenth St., Los Angeles.

Another is said to be quite close to the railroad station at Acton, T. 5 N., R. 13 W. The ownership of this is unknown.

Bibl.: Cal. State Min. Rept. XV. The Mineral Resources of Los Angeles County, 1916.

MARIPOSA COUNTY.

Purcell-Griffin Mine. Shipments of chromite were begun early in May, 1918, by Thos. Purcell and Geo. Griffin from a deposit near Pleasant Valley station on the Yosemite Valley Railroad, southeast of Coulterville. This is the first production of chromite, of record, from Mariposa County. It is reasonable to expect that others may follow, as there are a number of serpentine lenses associated with the Mother Lode gold belt in this county, similarly to the occurrences in the districts to the north of this.

MENDOCINO COUNTY.

A few deposits of chromite are being developed in this county, but to date there has been no production. The deposits are all rather inaccessible, usually being located close to the summits of high mountain ranges. The serpentine areas in which they occur are extensive, particularly in the vicinity of Big Red Mountain, near the northwestern border of the county. The difficulty with most of the ore is its low grade, the richer ore occurring as small irregular veins or bunches in these low grade bodies. Without concentration, these deposits will not become important producers, as the rich pockets are too small and

irregularly deposited throughout the serpentine areas to supply any large demand.

Big Red Mountain Deposits. This mountain covering Sections 18, 19, 20, 29, 30, 31 and 32, T. 24 N., R. 16 W., is capped with a soft, red, decomposed serpentine soil in which occur abundant chromite boulders and sand. This has led to the belief that there are large bodies of chromite beneath, and, as a result, over a hundred claims have been located. Those holding claims here at present are:

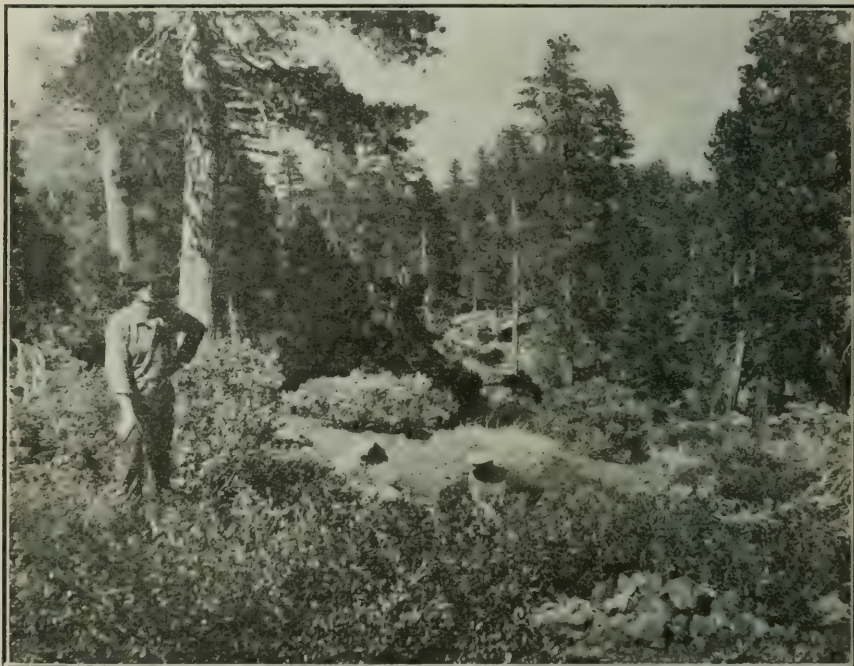


Photo No. 31. Summit of Red Mountain, Mendocino County, showing location of largest lens of chromite found there.

Frank Asbil, Alex. Guthrie, and Mrs. Frank Root, Alder Point, Cal., 45 claims.

E. Frazer of Cummings, 16 claims.

R. E. Roach of Cummings, 26 claims.

E. Winter, 522 Hearst Bldg., San Francisco, 30 claims.

During the summer, development work was being done at the **Asbil, Guthrie** and **Root** claims. These extend along the summit of the ridge for over a mile, varying in elevation from 4300 to 4700 feet above sea level. The State Highway from Longvale to Garberville (now in course of construction) passes 1 mile west of the group. The claims are now reached by trail, 3 miles long from the Cummings-

Alderpoint Road. The nearest railroad station is Longvale, approximately 30 miles by road to the south. Considerable float is found over the mountain, and the soil shows traces of the chromite sand throughout the claims. The owners state that the chromite content in this soil varies from 1 to 2%. Ten lenses of high grade ore have, to date, been uncovered. The largest of these is exposed by a shallow cut, over

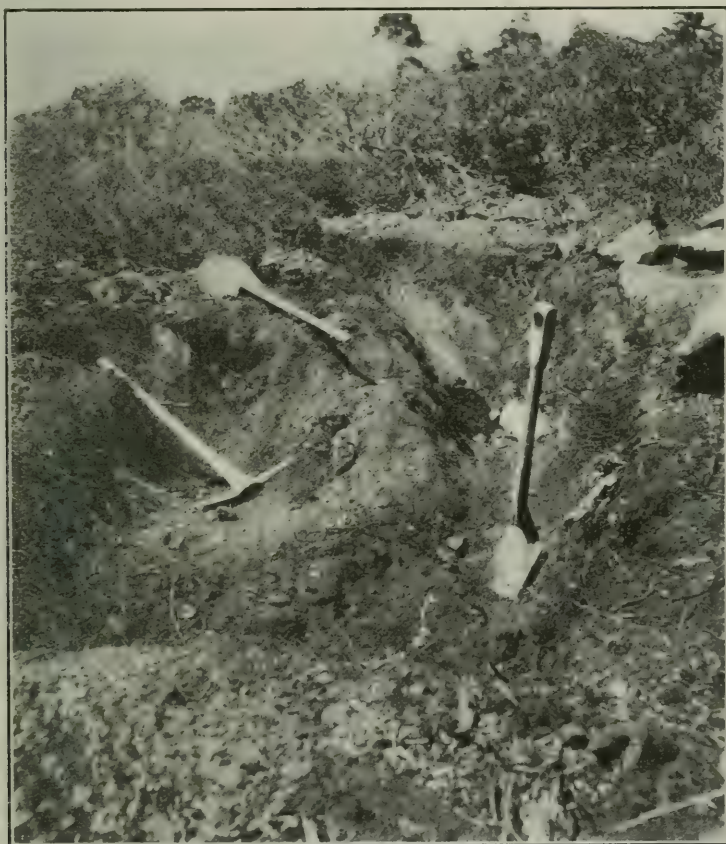


Photo No. 32. Asbil & Guthrie Chrome Claims, Mendocino County. Trench exposes a lens of high-grade chromite, 4' wide and 10' long.

an area 30 ft. wide and 60 ft. long. The depth is unknown, but it appears to be in the form of a blanket lying almost flat, and will probably not be over a few feet in thickness. The other pockets or lenses are exposed by trenches. They are all small, varying from 1 to 3 feet in width and up to 6 feet in length. About 30 tons of the high grade black chromite are lying on the several dumps. Samples of this ore assayed by the Pacific Coast Steel Company showed 55.38% chromic oxide and 0.68% silica. The owners expect to ship out the high grade

ore and concentrate the richer portions of the soil. Water for concentration purposes can be obtained from a large flowing spring on the property. This is said to flow throughout the year. No concentration tests have, as yet, been made, and it is very doubtful whether this property will develop into a producer in the immediate future.

Graham Deposit. A group of nine claims was located in 1916 by W. S. Graham of Ukiah, 4 miles northeast of Largo Station, near the

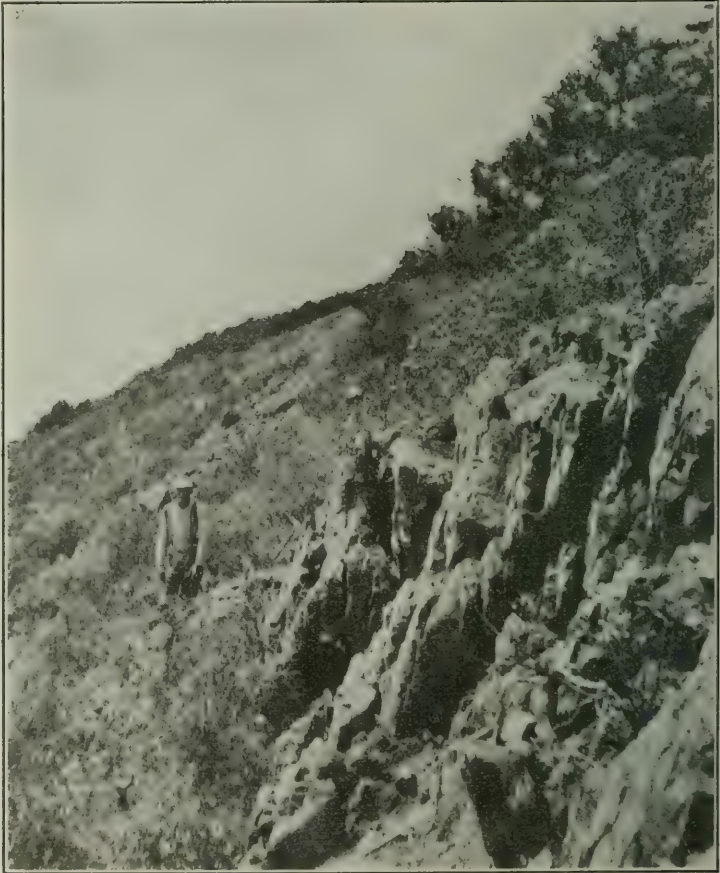


Photo No. 33. Large cropping of serpentine impregnated with minute chromite crystals, on the Noble Electric Steel Company's lease, near the summit of Red Mountain, southeast of Ukiah, Mendocino County.

summit of a ridge, which forms the divide between Mendocino and Lake counties at this point. The elevation is 4200 ft. above sea level, over 3000 ft. above the floor of the valley. An old wagon road leads to within 1 mile of the claims, but it would have to be repaired before any hauling could be done over it.

The chromite occurs as small particles disseminated through serpentine, which outcrops along the top of the ridge in well defined ledges, striking northwest and southeast. In places there are stringers and kidneys of the gray ore, which appears to be fairly high grade, but these are irregularly distributed and grade imperceptibly into the serpentine. Judging from the amount of the low grade ore exposed in the croppings, which can be traced at intervals for about $\frac{1}{2}$ mile,



Photo No. 34. Tunnel at Noble Electric Steel Company's Red Mountain lease, driven to crosscut ledge shown in Photo No. 33.

this property should offer a good field for concentration. The Noble Electric Steel Company of San Francisco are developing three of the claims under a lease. Development work consists of a dozen small cuts and trenches along the outcrops from which about 100 tons of ore, which it is reported assays 26% chromic oxide, were mined. Some rich pockets were encountered and probably 20 tons of ore which will go better than 40% chromic oxide, are lying on the dumps. The company is now driving a tunnel to cut a ledge which outcrops for several hun-

dred feet, carrying considerable chromite disseminated through it. It is reported that the leaser is trying to block out sufficient low grade ore to warrant the construction of a small concentration plant. Water for milling purposes is available in 2 large flowing springs, a couple of hundred feet below the workings. Three men are employed. Ray Rennick of Ukiah is foreman.

Little Red Mountain. Deposits of chromite occur on this mountain which lies directly north of Big Red Mountain, being separated from it by Cedar Creek, a tributary of the Eel River. Conditions here are the same as at Big Red Mountain, and at the present writing, no development work has been done on the claims located. It is reported that only one lens of ore has been found in place, but chromite float and sand are abundant over the slopes. Charles Artward, George Kindred, and J. M. McKnight of Covelo, recently located four claims here.

W. E. Shields of Covelo, has gathered about 30 tons of high grade chrome ore, said to assay over 50% chromic oxide, that he found lying over the surface in an area of serpentine in Section 11, T. 23 N., R. 11 W., 25 miles northeast of Dos Rios. No ore has as yet been uncovered in place. The region is very inaccessible, being over 5 miles to the nearest road and in a rugged region. Two claims have been located here and the owner expects to do some prospecting work during the summer. The ore has not been shipped out.

Occurrences of chrome ore are reported at several localities along the Middle Fork of the **Eel River** and its tributaries, but they are too inaccessible to be commercially important and are undeveloped.

MONTEREY COUNTY.

Occasional small masses and float of chromite have been found in the serpentine of Table Mountain near Parkfield. So far, none has yielded a commercial production.

There are possibilities of locating chromite deposits in the southwestern corner of Monterey County, in the northerly extensions of the serpentine areas noted in San Luis Obispo County to the south.*

NAPA COUNTY.

Chrome Center Claim. It is in Section 36, T. 10 N., R. 5 W., 22 miles north of Rutherford, the nearest railroad station. The Walters Springs road goes within one mile of the claim, which is reached by trail from the Springs. A fairly high grade body of massive gray chromite occurs in a lens in serpentine. It is developed by an open cut 20 ft. long, showing in places, 5 ft. of ore. About 30 tons have been mined and are lying on the dump. Seventy-five yards east of this cut, there is another cropping of chrome ore, but it is small and has not been developed. This

*Since the above was written, the Daisy Chrome Co. reports it is developing a body of chromite near Jolon and has 1000-1200 tons in sight. Ben Williams, Jr., is manager.

is a very recent location and the owner expects to do some further work to expose the ore body, with the purpose of selling or leasing it on a royalty basis. Roy W. Wallace, Pope Valley, Cal., is the owner.

Cigarette—Placer Chrome Mine, W. N. Noel, Montebello, owner. This prospect is in the Knoxville district, 35 miles from the railroad at Winters, Yolo County, and was located in the fall of 1917. A depth of 35 feet on the vein has been driven, and the ore is stated to show 48% Cr_2O_3 .

Sullinger Prospect. A small lens of high grade chrome ore occurs on a side hill 300 ft. north of and above Conn Creek, five miles east of Rutherford, on the Pope Valley Road. It is exposed in a pit sunk 6 ft., showing a pocket 3 ft. long and 6 to 18 inches wide. Six feet west of the pit, a small cut was made, this cuts the lens, but no further work has been done on it. About 500 lbs. of ore are lying on the dump. The property is idle. W. Kilpatrick of Oakville, is agent.

NEVADA COUNTY.

The **Mount Hill** chrome mine is in Sec. 13, T. 17 N., R. 10 E., M. D. M., south of Washington, near the road to Nevada City, at an elevation of 4160'. It is owned by George Scott of Washington.

About thirty tons of 45% chrome ore had been taken from a lens striking N. 10° E. and pitching 65° E. Development work consisted of a pit 6' wide, 10' deep and 14' long, showing an ore on the south face 4' wide and 5' high, opened for 5' along the orebody. From a small area 14' farther south, along the strike of the orebody, a 6' pit about 8' square has yielded 6 tons of float chrome: clay was being worked in the bottom with hopes of striking more ore below. No ore had been shipped.

The **Moscatelli** property, on Poorman's Creek, is in Sec. 1, T. 17 N., R. 10 E., M. D. M., two miles northwest of Washington, at an elevation of 2960'. It is owned by Peter Moscatelli and H. O. Kohler of Washington.

A lenticular body of chromite in serpentine was striking N. 15° W. on the south slope of a spur ridge on the west side of Poorman's Creek. The ore body was 8' wide in the center, at the surface, and pinched at a distance of 10' to the south; it took the form of an irregular slab at a distance of 10' to the north. Twenty tons of ore had been mined, which would probably average 45% Cr_2O_3 ; considerable wall rock was added during the last work, which probably lowered the average percentage considerably. An assay of the surface ore is said to have shown 54% Cr_2O_3 .

Nevada County Chrome Company, Nevada City. F. S. Morgan, mgr. Ten 1200 pound stamps of the old Oustomah mill, on the edge of town, have been pressed into service for crushing chromite ore. The

stamps are fitted with 15-mesh screens and crush four tons of ore each in 24 hours. From a Hendy classifier the fines and slimes are sent over two Johnson belt concentrators (also part of the equipment formerly used in quartz milling) and the coarse pulp goes to an Overstrom concentrator. Middlings are to be returned by a bucket elevator to the classifier for concentration on a separate Overstrom table, now being installed.

As soon as this mill is in successful operation Mr. Morgan plans to build another plant at the company's mines near Limekiln. The Ous-tomah plant will then be operated as a custom mill.

The **Redledge** chrome mine is in Sec. 13, T. 17 N., R. 10 E., M. D. M., one mile south of Washington, at an elevation of 3740'. It is on the property of the Redledge gold mine, owned by Williamson Bros. and Clyde Cole of Washington.

Development work has been carried on near the road from Nevada City to Washington. On the east side of the road an open cut has been made on the side hill from 2' to 14' deep and 40' long, along a strike of N. 60° W. About 70 tons of ore, averaging over 42%, were produced and from all appearances the workings should yield a greater tonnage with depth.

On the west side of the road, on the upper face of the slope of the hill, is an open cut 30' deep and 50' long on a body of ore which was 20' wide at the top and 10" wide in the bottom. About 600 tons of ore had been produced and it appeared likely that the ore body would continue through the hill. An ore shoot 2' wide and 8' long was exposed at a distance of from 6' to 8' northeast of the main workings and looked as though it might unite with it in depth.

The air compressor at the Redledge gold mine furnishes power for a 150' incline hoist and for drills.

The **Turtledove** chrome property is in Sec. 1, T. 17 N., R. 10 E., M. D. M., at an elevation of 2780', about one mile northwest of Washington. It consists of one claim owned by Walter Niles, Fred Miller and H. O. Kohler of Washington.

Development work had been done on a spur ridge on the east side of Poorman's Creek. On the south side of the ridge about 20 tons of good ore had been taken from a lens striking N. 10° E.; it had been opened up by a cut 4' deep, 2' to 4' wide, and 25' long. On the north side of the ridge, 75' north of the other workings, a prospect hole 6' long, 4' wide and 5' deep had found only traces of chromite along a north-south seam in the serpentine. An assay of a sample of ore taken near the surface is said to have run 52.16% Cr_2O_3 .

The **Woil** property is reported to lie two miles northeast of Grass Valley. Ten tons of ore are said to average 56.68% Cr_2O_3 were pro-

duced, but no more ore was found. The ore was purchased by T. F. Hogan of Grass Valley.

The **Wolf**, or **Limekiln**, chrome deposit is in Sec. 4, T. 14 N., R. 8 E., at an elevation of 1480', 14 miles northwest of Auburn. The property is owned by H. Thompson of Wolf, and leased by Guy Walsh and Mr. Hall of Auburn.

A series of chrome lenses strike N. 40° W. and pitch 80° NE. The main working consists of a pit 4' wide by 8' to 10' long by 10' deep. The ore exposed on the footwall is granular and carries considerable silica. The solid orebody carries a fine grained mixture of chrome and magnetite. About 30' southeast of this is another pit 3' wide by 6' long by 10' deep, in which a cross-stringer has been opened up along the southeast end; this stringer was exposed 14" wide by 4' long by 4' deep and struck in a northwesterly direction; it had been traced for 75' farther northward by an open cut from 2' to 3' deep. About one-half of the ore exposed had been mined. It is reported that H. C. Schrober of Nevada City, shipped 55 tons of 35% ore from this property in 1916.

A carload of chrome ore is reported to have been shipped from the **Sweet** ranch, one mile south of the Thompson ranch, in 1916. It is also reported that there is considerable low grade chrome in the N. $\frac{1}{2}$ of the NE. $\frac{1}{4}$ of Sec. 16, T. 16 N., R. 8 E., three miles northwest of Grass Valley.

PLACER COUNTY.

The **Bunker** property is in Sec. 21, T. 14 N., R. 11 E., M. D. M., at an elevation of 3260', one mile northwest of Michigan Bluff. It is owned by H. H. Bunker of Michigan Bluff and was leased by the Union Chrome Company of San Francisco.

Lenses and chimneys of chromite occurring in serpentine have been developed by tunnels, shafts, and open cuts. At an elevation of 3260' a 64' tunnel has been run east-west; 18" of ore is exposed for 12' along the roof. The ore averaged about 40%, of which there was approximately 60 tons in a pile and about 10 tons in sight in the tunnel. At an elevation of 3250' a short 10' tunnel was being run along the same ore body, exposing it 4' wide and 10' long; about 35 tons of ore were in sight.

At an elevation of 3280' a 50' tunnel had exposed an ore body 40' long striking east-west. The body pinches out in the face of the tunnel, but is exposed 30" wide for a distance of 30' along both the floor and roof of the tunnel. About 100 tons of 45% ore were piled and there was at least 65 tons in sight to be mined.

At an elevation of 3310' a chimney-like body of ore was opened up by a 10' open cut 6' wide, on which some work had been done in former years. The chimney was 3' in diameter and about 10 tons of ore,

probably averaging from 40–45% Cr_2O_3 , were in sight. About 15 tons of float chrome had been grubbed from an area 50' long down the slope of the hill. Some of this ore showed fine crystals of uvarovite, or chrome garnet.

On the nose of the ridge at an elevation of 3360' a shaft had been sunk 50' on an ore body which struck N. 55° W. and pitched 70° SE. Ore carrying from 40% to 45% Cr_2O_3 was exposed on the northwest face and on the lower 30' of the southeast face which averaged 2' wide. About 60' tons had been taken out, to date, of which 30 tons were on a loading platform. At least 30 tons of ore were in sight.

Eight men were employed at the property on June 17, 1917, and 250 tons of ore had been produced.

The **De Kruse** property is in the S. $\frac{1}{2}$ of Sec. 30, T. 15 N., R. 11 E., M. D. M., at an elevation of 3600', $\frac{1}{4}$ miles east of Iowa Hill. E. De Kruse owns 6 claims which are timbered with sugar and yellow pine.

Float chrome was being taken from pits and open cuts less than 6' deep. About 10 tons were piled for hauling. The ore occurs in a westerly continuation of ore bodies being worked by R. L. Turner.

The **Fiddler's Green** property is in the NE. $\frac{1}{4}$ of Sec. 29, T. 13 N., R. 9 E., M. D. M., about $2\frac{1}{2}$ miles south of Dodds and 14 miles northeast of Auburn. It lies at an elevation of 1450' on the rugged, steep, northern slope of the Middle Fork of the American River. It was leased by Messrs G. Walsh and Hall of Auburn, who had men employed to develop it.

Lenses of chrome occur along the contact of serpentine and amphibolite schist. At the original location a stringer of chrome ore struck N. 80° E. at an elevation of 1450'. It was developed by four open cuts, each 4' deep and 10' long and by a 12' shaft. The ore occurs in bunches along the serpentine talc contact; it is fine grained and carries considerable magnetite. About five tons of 32% ore were on the dump. An analysis by Geo. A. James Co. of San Francisco follows: Cr_2O_3 , 32.3%; SiO_2 , 13.0%.

At an elevation of 1400' an upper open cut was 18" deep and 30' long. The ore struck N. 60° E., pitched 60° SE. and followed a small veinlet of low-grade slip fiber asbestos. About 4 tons of low-grade ore were on the dump.

E. A. Garrison of Forest Hill reports prospects of chrome on properties one mile southeast of Forest Hill. No development work had been done.

The **Gas Cañon** property is in the Spring Garden district, in Sec. 13, T. 13 N., R. 9 E., M. D. M., one mile south of Dodd's and 13 miles northeast of Auburn, the shipping point. It lies at an elevation of 1750' in

a rugged cañon. The property was being operated by Messrs. G. Walsh and Hall of Auburn.

A chimney of chrome ore, in serpentine, had been developed by a shaft 4' x 6' x 10' deep. The ore was of high grade and some uvarovite, or chrome garnet, occurred with it. A car of ore mixed with some from the Green property averaged 34% Cr_2O_3 .

The **Green**, or **American**, property is in the Spring Garden district in the SE. $\frac{1}{4}$ of Sec. 12, T. 13 N., R. 9 E., M. D. M. It lies at an elevation of 1850', 13 miles northeast of Auburn. It is on property owned by Jas G. Dodds et al., of Westville, and leased by G. Walsh and Hall of Auburn.

A lens of chrome striking N. 35° W. had been followed by a 24' shaft with drifts 12' long in a NW.-SE. direction. No ore was exposed in the workings. An analysis, of ore taken out, by Geo. A. James Co., of San Francisco, follows: Cr_2O_3 , 21.1%; SiO_2 , 12.0%.

Some open cut work had been done on the Dodd's property, in the same section, about $\frac{1}{8}$ mile southeast of the house. A small amount of low grade ore was in sight. An assay of ore from the southernmost pit follows: Cr_2O_3 , 20.4%; SiO_2 , 18.0%.

In August, 1918, it was stated that this property had been sold.

The **Linder** and **Hodges** property lies in Sec. 25, T. 16 N., R. 10 E., M. D. M., about two miles northeast of Alta. It consists of a 320-acre patent owned by R. E. Linder of Alta and J. R. Hodges of Towle.

The older workings are in the NW. $\frac{1}{4}$ of Sec. 25 at an elevation of 3560'. Development consisted of a 30' tunnel and 10' raise. About 25 tons of ore were taken from the tunnel and 157 tons are said to have been found as float. This ore was shipped in 1916 and the workings had not been opened up since.

About $\frac{1}{4}$ mile northeast of the older workings, at an elevation of 3950', a vertical lense of chrome was found to strike N. 20° W. A portion of the ore body exposed had a face 3'x5' and probably carried 40% Cr_2O_3 . This portion appeared to have slipped from about 10' above, where another body 2'x3' of the same ore was exposed in the gulch. Some ore in stringers to the northward was mottled and granular and probably did not carry over 38% Cr_2O_3 . About 10 tons of mixed ore, which would carry about 35% Cr_2O_3 , were piled for hauling. The wall rock is sluiced away by water taken from the Pacific Gas and Electric Co. ditch at an elevation of 200' above the deposit.

Ivan H. Parker property. Prospecting on this land, 6 miles north east of Auburn near the Grass Valley road, indicated the presence of a large body of concentratable ore, estimated to carry 18% to 20% chromite and outcropping 300'. Work has not gone far enough to

define the dimensions of the body, but a shaft 31 feet deep, with a cross-cut 60 feet from the bottom, were in ore. The owner, Ivan H. Parker of Auburn, has leased to F. W. McNear, 514 Kohl Bldg., San Francisco.

McNear has just installed a small open air plant for concentrating. The soft ore is fed without crushing into a Centralized ball mill of 50 tons capacity and the pulp goes without classification to Gates concentrators. Only trial runs have been made to date (May 8, 1918).

On the **H. Scheirmeier** property at Michigan Bluff a prospect of chrome was found. The ore appeared to follow a contact of serpentine and talc just back of the house.

The **Sugar Pine** chrome properties are in Secs. 29 and 31 of T. 15 N., R. 11 E., M. D. M., of the Damascus Mining district. They lie in a wooded portion of the Forest Hill Divide, at an elevation of 3600', about 6 miles northeast of Iowa Hill. The nearest shipping point is Colfax, 27½ miles southwest by way of Forest Hill. The road from Iowa Hill to Colfax is too steep for hauling purposes. The property is owned by the Power Timber Company of San Francisco and leased to R. C. Turner of Grass Valley. Trucking of the ore to Colfax costs \$7.50 per ton.

Lenses and chimneys of chromite in serpentine are being worked by open cuts and inclines. A 40' incline on Sec. 29 has opened up an ore body striking east-west and pitching 30° S. The ore is 9' thick in the face and carries 45% Cr₂O₃. This same ore continues northward for 50', where it is said to be 3' thick at a depth of 40'; the old workings were full of water. A steam boiler runs a pump for dewatering the working incline. Six men were employed at these workings and 1000 tons of ore had been shipped up to June 17, 1917.

At an elevation of 3600', in Sec. 31, a 16' shaft exposes soil carrying decomposed chrome for a depth of 10' and solid chrome ore for the lower 6'. The ore body is 8' wide, has been opened up for a distance of 14', and appears to strike east-west with a pitch of 50° to the south. Approximately 40 tons of ore had been corded, which appeared to carry about 50% Cr₂O₃.

On a ridge about ¼ mile above the last workings a 16' incline had been run in weathered chrome. The ore body strikes east-west, at an elevation of 3700', and the upper portion of it has apparently migrated down the hill in course of weathering. The main ore body pitches rather steeply to the south, at an angle of about 65°, while the upper portion pitches only 10°-20° south. About 40 tons of ore had been taken out up to June 17, 1917. The surface rock carries a great deal of iron oxide, much of which is in shot-like nodules; this is red on the surface and yellow below.

Six men were employed in these scattered workings. The upper, fine ore was more or less mixed with soil and was being concentrated by R. L. Turner and C. A. Geisendorfer.

A large pit in Sec. 31, at an elevation of 3520' and southwest of the last workings, exposed an ore body striking N. 80° W. and pitching 80° N. The upper 6' of ore had only a slight northerly pitch. About 60 tons of ore were corded. In an old open cut 6' deep and 50' long ore was exposed 2' wide for a distance of 30'. Just south of the pit, open cut work had been done, over an area 20'x40', and considerable float chrome recovered. About 40 tons are said to have been shipped in the fall of 1916 and 30 tons more were piled for shipment from an area 150' farther east. Still farther south is an old shaft, filled with water, which had been worked in 1884-85. Northwest of the pit an open cut, made in early days, had been run N. 40° W. for a distance of 250'; at the southeast end of it a pit 14' in diameter and 10' deep had been sunk and considerable ore taken out.

Farther north in the same section, at an elevation of 3510', an open cut had been made in a line N. 50° W. The open cut was 5' deep and 150' long and 20 tons of ore had been taken out, which assayed 55% Cr₂O₃ and 2% SiO₂.

The **Sullivan** chrome property is in the N. ½ of the NE. ¼ of Sec. 19, T. 16 N., R. 11 E., M. D. M., 2 miles by road and trail northeast of Alta. It is on an 80-acre patent purchased from the Central Pacific railroad by D. J. Sullivan of Dutch Flat, and W. F. Hemphill and R. E. Noble of Roseville.

Lenticular bodies of chrome ore, occurring along fractures in serpentine, were being mined on the southeast bank of Bear River. Development work consisted of a 65' tunnel which follows a 2' body of chrome ore, striking N. 25° E. A 25' crosscut working tunnel was run to the south and a 10' raise made. A 50' tunnel had been run in a direction N. 60° W. along a 2' cross-vein which pitches 50' S. About 90 tons of ore running from 40-45% Cr₂O₃ had been mined. About 15 tons of granular ore carrying from 38-40% Cr₂O₃ had been taken from a 6' pit on the slope about 60' above the tunnel level.

The **Turner and Geisendorfer** Chrome and Concentrator Company hold three claims in the NE. ¼ of Sec. 30, T. 15 N., R. 11 E., M. D. M., 6 miles northeast of Iowa Hill. It lies at an elevation of 3550' about 27½ miles northeast of Colfax. The company consists of R. L. Turner of Colfax and C. A. Geisendorfer of Weimar.

Open cuts and pits have yielded over 200 tons of ore. Eighty tons shipped in 1916 carried from 42-47% Cr₂O₃. The chrome bearing area lies along a westerly extension of deposits on the Sugar Pine property.

A small concentrating plant consisted of two Dykes tables operated by a $2\frac{1}{2}$ h.p. gas engine. Two men were employed, one to screen the material and one to attend the tables and remove the concentrates. The coarser material, which did not pass the screen, was mixed with the concentrate, which probably averaged about 40% Cr_2O_3 . No concentrate had been shipped up to June 17, 1917.

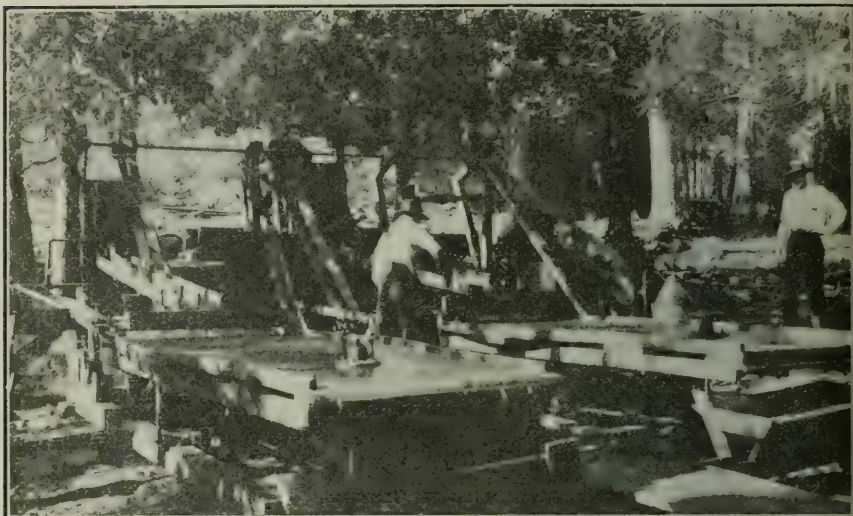


Photo No. 35. Concentrating chrome ore near Sugarpine Mill, Placer County, on property of Turner & Geisendorfer.

The **Williamson** and **Beck** property is in Secs. 19 and 30 of T. 15 N., R. 11 E., M. D. M., 5 miles northeast of Iowa Hill. It consists of two claims, the Iowa Hill Chrome, and Iowa Mine #2, including 80 acres in Sec. 19 and 55 acres on government land in Sec. 30. It lies at an elevation of 3500 ft., more or less, near an eastern branch of Shirt Tail Cañon. It is owned by W. S. Macy and Wm. Haler, and leased to O. S. Williamson and C. Beck of Iowa Hill.

Lenses of chromite, in serpentine, have been developed by shafts and open cuts. On Sec. 19, $\frac{1}{2}$ mile south of camp, about 5 tons of float had been taken from a 10' pit which was connected with an open cut. Approximately 100 yards farther east was a 10' shaft, with windlass, from which some ore had been taken. About 2 tons of float chrome were piled near by.

In Sec. 30 the lessees had worked 9 days, up to June 18, 1917, on an ore body 4'-5' wide and 16' long. The body was lenticular and struck north-south in serpentine. About 10' farther north was another lens, offset from the last one, striking NW.-SE., and open cut 3' wide and 12' long. About 60 tons of ore were corded for shipment.

PLUMAS COUNTY.

The **McCarty** chrome property is in Sec. 14, T. 23 N., R. 9 E., M. D. M., being 10 miles southwest of Quincy, the nearest railroad station. It consists of two claims called Jitney #1 and Jitney #2, owned by Thos. McCarty of Quincy and leased on royalty to the Union Chrome Company of San Francisco.

The principal ore body exposed was on Jitney #1 claim, located on the east bank of the Middle Fork of the Feather River at an elevation of 3400'. It consisted of a lens of solid chromite 6' wide in the center and 80' long; the southern 20' of the ore body had been offset a distance of 5' by a fault. The ore body struck N.-S. and pitched 80° W.



Photo No. 36. McCarty chromite deposit on Feather River, 8 miles south of Quincy, Plumas County, leased to Union Chrome Company.

in a fine-grained metamorphic limestone; this appears to be the only record of chromite occurring thus associated.

Development work consisted of an open cut 40' long, with 6' face, along the ore body. Four men had been employed for two weeks and had taken out 46 tons of ore said to assay from 45-48% Cr_2O_3 . About 300 tons of ore appeared to be in sight down to a depth of 10' below the outcrop. No definite arrangements had been made for moving the ore, which would have to be packed or trammed to a height of 3000 feet over a very steep, rocky, rugged mountain slope to a very steep road leading from the vicinity of Claremont Hill to Quincy, a drop of 3000 feet in elevation. The property is inaccessible, on account of snow, from December until the middle of June.

The **Valley View** chrome property is near Greenville. It is owned by W. P. Boyden and Fred Koenig of Greenville, and leased on royalty to A. E. Vandercook of Oakland, who is reported to have transferred his lease to the Western Ores Co.

It is said that one car of ore was shipped in 1916 and two cars in 1917, which assayed about 32% Cr_2O_3 . The property was idle in July, 1917.

Norris & Noyes of San Francisco, were reported¹ in November, 1917 to be shipping one car of chrome ore per day to Niagara Falls, N. Y., the ore being hauled by motor trucks to Swayne Station.

SAN BENITO COUNTY.

In the serpentine areas in the Coast Range Mountains, chromite is occasionally found. One such area which is quite extensive occurs south and southeast of New Idria.² Within this area an abundance of chromite is found as small float, especially in the ravines and stream gravels. It does not, so far as observed by the writer, occur in any considerable bodies but seems to be disseminated in boulders and small masses throughout portions of the serpentine. Centuries of weathering and erosion have concentrated this mineral in the stream gravels. About 1875 a party of four men, with teams not otherwise engaged at the time, hauled out to Hollister a carload or two of the coarser of this natural concentrate, shipped it to San Francisco and thence by sailing vessel to Baltimore. The workable deposits were so scattered, and limited in extent, and the margin of profit was so small (they did actually make a slight profit) that they discontinued the experiment.

During 1917, various individuals, mostly Mexicans living in this district, collected small lots of chrome ore which they sold to ore buyers. They carried the ore to the main roads by sleds, pack-mules and wagons, from which points motor trucks transferred it to the railroads. Most of it went out via Mendota; but some also via Coalinga, King City and Hollister. In this manner, a total of between 400 and 500 tons was shipped.

The chromite here is characterized by specks and films of a green oxidation product. In early days this was erroneously reported as nickel and also as "hornsilver," though the color is a more vivid green than the latter mineral.

Bibl.: Rept. IV, p. 136; VI, Pt. I, p. 100; VIII, pp. 483, 490; XV, p. 630; Mines and Mineral Res. of Monterey et al., counties, p. 36; Bull. 27, p. 126; Bull. 38, pp. 269, 362; Bull. 67, p. 81; MIN. RES. W. OF ROCKY MTS., 1868, p. 224; CAL. SEN. DOC. No. 9, 1854 (J. B. Trask), p. 18; U. S. GEOL. SURV., Bull. 603, p. 208; Mon. 13, p. 294.

¹Min. & Sci. Press, Nov. 24, 1917, p. 770.

²Mines & Mineral Res. of Monterey et al. counties; Cal. State Min. Bur., chapters of State Mineralogist's Report, biennial period 1915-1916, pp. 36, 197.

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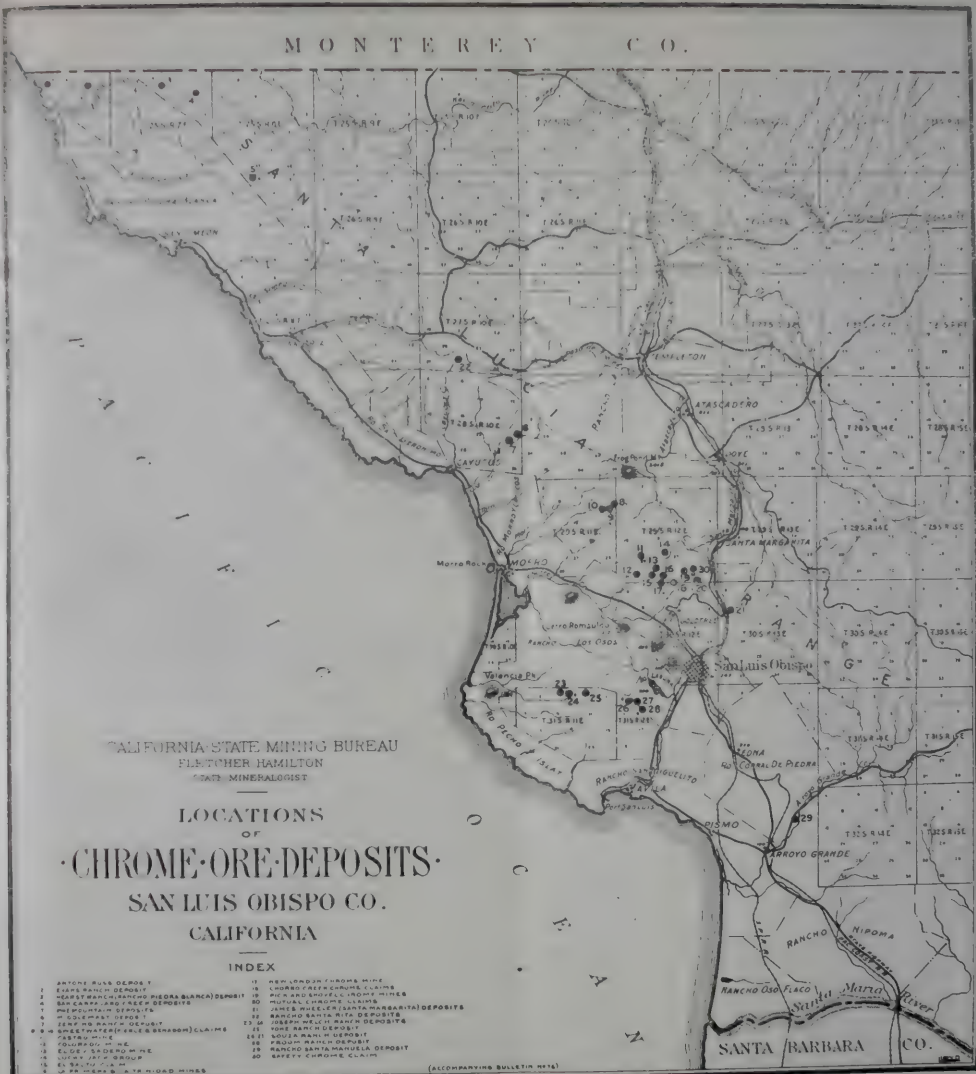
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CALIFORNIA STATE MINING BUREAU
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LOCATIONS
OF
CHROME ORE DEPOSITS.
SAN LUIS OBISPO CO.
CALIFORNIA

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[ALCOHANYING BULLETIN #74]

SAN LUIS OBISPO COUNTY.

“As a mining county, San Luis Obispo is most widely known for its production of chromic iron. In years past many mines were worked here, but, owing to the low prices obtained in recent years, nothing is now being done. Chromic iron occurs, however, in large quantities and, under favorable conditions, will again be mined.”¹

At the present time, 13 years after the above was written, it is interesting to note that, while quicksilver production also adds largely to San Luis Obispo's fame as a mining county, the chromic iron mines are, under present favorable conditions, fulfilling the above prophesy, and supplying a steady tonnage of ore to an eager market.

A general description of the chromic iron ore deposits and their geological occurrence is given by E. C. Harder, U. S. G. S. Bull. #430, and by H. W. Fairbanks in the folio quoted above. An excellent review of the geology, and a history of the San Luis Obispo County mines is found in “The Mines and Mineral Resources of San Luis Obispo County,” recently issued by this Bureau. It has seemed advisable to refer the reader who wishes to investigate from that angle, to these publications, and to place emphasis herein, rather on data which it is hoped will be of immediate and practical aid toward economic development. A map (Plate III) has been included showing the location of chrome ore deposits and the list of chrome properties discussed is believed to cover all known occurrences.

Alviso and Sunshine Claims. These claims are located in Sec. 34, T. 29 S., R. 12 E., on the western slope of the Santa Lucia Range, on the road to the Pick and Shovel Mine. Only a small amount of development work has been done on the claims—P. A. H. Arata, et al., owners. Under lease to Noble Electric Steel Company. This company is employing a large force of men in developing and prospecting the claims.

Castro Mine. This mine is situated in the east half of Section 29, T. 29 S., R. 12 E. It is on the southwestern slope of the Santa Lucia Range, six miles northwest of San Luis Obispo. There has been a considerable production from this property in the past, but on account of low prices it was closed down before the ore bodies were exhausted. The Trinidad Mining Company has recently reopened the property. They mined the ore by means of an open cut. Their early production was at the rate of 20 cars, about 1000 tons, per month. Twelve men are employed.

Several carloads of ore were shipped from this property, via Goldtree Station north of San Luis Obispo, but in spite of great care in sorting the ore, it was found nearly impossible to get carloads averaging over

¹Fairbanks, H. W., Geologic Atlas of U. S., San Luis Folio (No. 101): U. S. Geol. Surv., 1904.

33% chromic oxide. The company consequently set about prospecting, in order to see if there was sufficient low-grade ore available to justify construction of a concentrating plant. Work on the hill at the end of the wagon road uncovered a lens 65 feet long and 28 feet thick which has not yet been bottomed, but has been proven to a depth of about 25 feet. This body carries some bunches of shipping ore, but the major part of it is stated to run about 20% Cr_2O_3 . No attempt will be made to sort out high grade, but the whole lens will be milled. Three other bodies of low grade ore were also found. When prospecting had revealed enough 20% to 25% ore to give a reserve of over 6000 tons, the management felt justified in putting up a mill. There is still a large unexplored area.

The mill has been built on the hill below the large orebody, and a tunnel has been driven to tap the ore at depth, so that tramping from the working face to the mill bin will be possible.

The crude ore is delivered to the mill in 14 cu. ft. cars and dumped into a 3'x8' grizzly with 1" openings. The fine falls through the grizzly directly into the mill feed bin. The coarse is put through a 12"x16" Dodge crusher, crushing to 1", and delivering directly into the 50-ton flat bottomed ore-bin. Power for the crusher is furnished by a 12 h. p. Orr and Sembower gas engine burning distillate. One shift on the crusher is generally sufficient to keep the mill bin well filled with crushed ore.

A Challenge feeder fastened to the ore-bin feeds the crushed ore to a 4'x3' Hendy Ball Mill, with a scoop feed. The mill revolves 30 times a minute and carries 2000 lbs. of chrome steel balls. The consumption of balls is about one-half pound per ton of ore crushed. The pulp from the mill is discharged over a revolving screen with .05 inch openings, and the oversize is returned by a bucket elevator to the mill feed box. Ball mill, feeder and elevator are driven by a Doak gas engine burning distillate. Nominally of 20 h.p., this engine actually develops 21 h.p. at this elevation (about 1500 feet). A clutch pulley on the ball mill pinion shaft enables easy starting of the load.

The pulp from the ball mill is delivered by a launder to a two compartment launder classifier from which the coarse and fine sands go to two Overstrom Universal Concentrators and the slimes to a 6 ft. Callow de-watering cone. The thickened slime from this cone is put over a Deister slimer. Two products, concentrates and middlings, are taken from the Overstrom tables, and tailings are run to waste. Power for the tables and for a 1½" centrifugal pump for returning clear water, is derived from a 7 h.p. Hercules engine burning distillate.

Water for the mill is pumped from San Luisito Creek, to a 10,000 gallon redwood tank by a 4" Woodin and Little triplex plunger pump,

driven by a 6 h.p. Orr and Sembower engine. All water from engine cooling systems and clear water from the dewatering cone and settling boxes is collected in a sump below the mill and returned by a 1½" centrifugal pump, running submerged, to a 3000 gallon redwood tank, and is used for ball mill feed water. Three tons of water is required for each ton of ore ground.

It is estimated that it will cost about \$2 a ton to concentrate the ore. When properly adjusted, the plant should be capable of making about 30 tons of concentrate a day. A new road has recently been completed to the mill and mine, and conditions favor heavy production. A. A. Wheeler, 1640 Clay Street, San Francisco, is the owner. The



Photo No. 36a. The 50-ton concentrating mill of the California Chrome Company at the Castro Mine, San Luis Obispo.

property is being worked under lease by the California Chrome Co., Home Office, Kohl Building, San Francisco, Cal.

Chisholm Mine. See **Pine Mountain Group.**

Chorro Creek Mine. Located in Section 34, T. 29 S., R. 12 E., near the summit of the Santa Lucia Range, and about 4½ miles north of Goldtree Station on the Southern Pacific Railroad. It contains 86.7 acres and is owned by W. C. H. Dibblee and P. A. H. Arata, of San Luis Obispo. Considerable chromite was shipped from the property during 1882 and 1883. The workings which are at an elevation of 1900 feet, consist of a few shallow open cuts and prospect holes, and outside of assessment work, no new work was being prosecuted when the property was visited. There is considerable chrome float scattered over the surface of the ridge. The wagon road to the property has very steep grades, which adds to the cost of hauling ore from the mine.

Colorado Chrome Mine. Claims covering 80 acres in the northeast half of Sec. 32, T. 29 S., R. 12 E., owned by George L. Mott and T. B. Gamble of San Luis Obispo, comprise this property. The workings consist of a number of shallow open cuts and small prospect tunnels.

Cypress Chrome Mine. This property adjoins the Chorro Creek Mine on the north. It contains 80 acres and lies in the northeast quarter of Sec. 34, T. 29 S., R. 12 E. It was located by Dibblee and Arata of San Luis Obispo and is little more than a prospect, no development work having been done.

El Divisadero Chrome Mine. It is situated in Section 33, T. 29 S., R. 12 E., 5 miles northwest of Goldtree Station, on patented land belonging to A. A. Wheeler, 1640 Clay St., San Francisco. It is under lease to the Trinidad Mining Co., office, L. H. Butcher Co., 214 Front St., San Francisco. A. A. Arata is superintendent. There is a little float chromite in sight.

El Salto Chrome Mine. This claim in the west half of Section 33, T. 29 S., R. 12 E., joins the El Divisadero on the south, and, like it, is the property of A. A. Wheeler of San Francisco, and under lease to the Trinidad Mining Co., 214 Front St., San Francisco. A few tons of float ore of good grade in pieces up to one foot in diameter are on the surface, and a small amount of prospecting is now being done. From the amount of old open cuts and prospect holes it is estimated that it produced several hundred tons of ore in the early 80's.

Evans Ranch. In Devils Cañon, which runs into San Carpojaro Creek in Sec. 2, T. 25 S., R. 6 E., a good quality of chromite is reported to occur. The deposit is six miles north of San Simeon on the W. J. Evans Ranch.

Froom's (Mrs.) Chrome Deposits. Mrs. Froom of San Luis Obispo owns some old chrome properties in the southern part of Rancho Laguna, $4\frac{1}{2}$ miles southwest of the city. There are 5 old tunnels on the property, one of which is still open for 50 feet. This tunnel is driven entirely in serpentine and shows some granules of chrome ore scattered through the rock. There is an old open cut with a face 40 feet high from which it is reported quite a tonnage of ore was extracted in the past. A small amount of prospecting has recently been done on the property. Dibblee and Arata of San Luis Obispo have an option on the deposits.

Johe Ranch Deposit. On the George M. Johe Ranch in the SW. $\frac{1}{4}$ of Sec. 2, T. 31 S., R. 11 E., some float and a small lens of chrome ore has been found. The deposit is 10 miles southwest of San Luis Obispo and 1500' above sea level. No development work has been attempted.

La Primera and La Trinidad Chrome Mines. Situated in the east half of Section 33, T. 29 S., R. 12 E., four miles north of Goldtree Station. The total area embraced is 180 acres of patented land. The mines are one mile west of the New London Mine, and at an elevation of 1500 feet. A tunnel has been driven west 460 feet, and a number of crosscuts have been driven north and south from the tunnel level. Three lenses of chromite have been developed, which have a general east and west trend and dip 40° to 45° to the north. A winze has been sunk on each lens to depths of twenty feet. It is reported that about 1000 tons of ore has been developed. At the elevation of open cut (1550 ft.) an incline has been sunk to a depth of 100 feet to extract the ore from the ore bodies developed on tunnel level.

From the information obtained from underground development, there appears to be a well defined ore zone which is approximately 125 feet wide, and has general north and south course. The ore is hauled to Goldtree siding. A. A. Wheeler of San Francisco, is the owner. The mines are being worked by the Trinidad Mining Company (L. H. Butcher Co.), 214 Front Street, San Francisco, Cal., F. W. McKee, Superintendent.

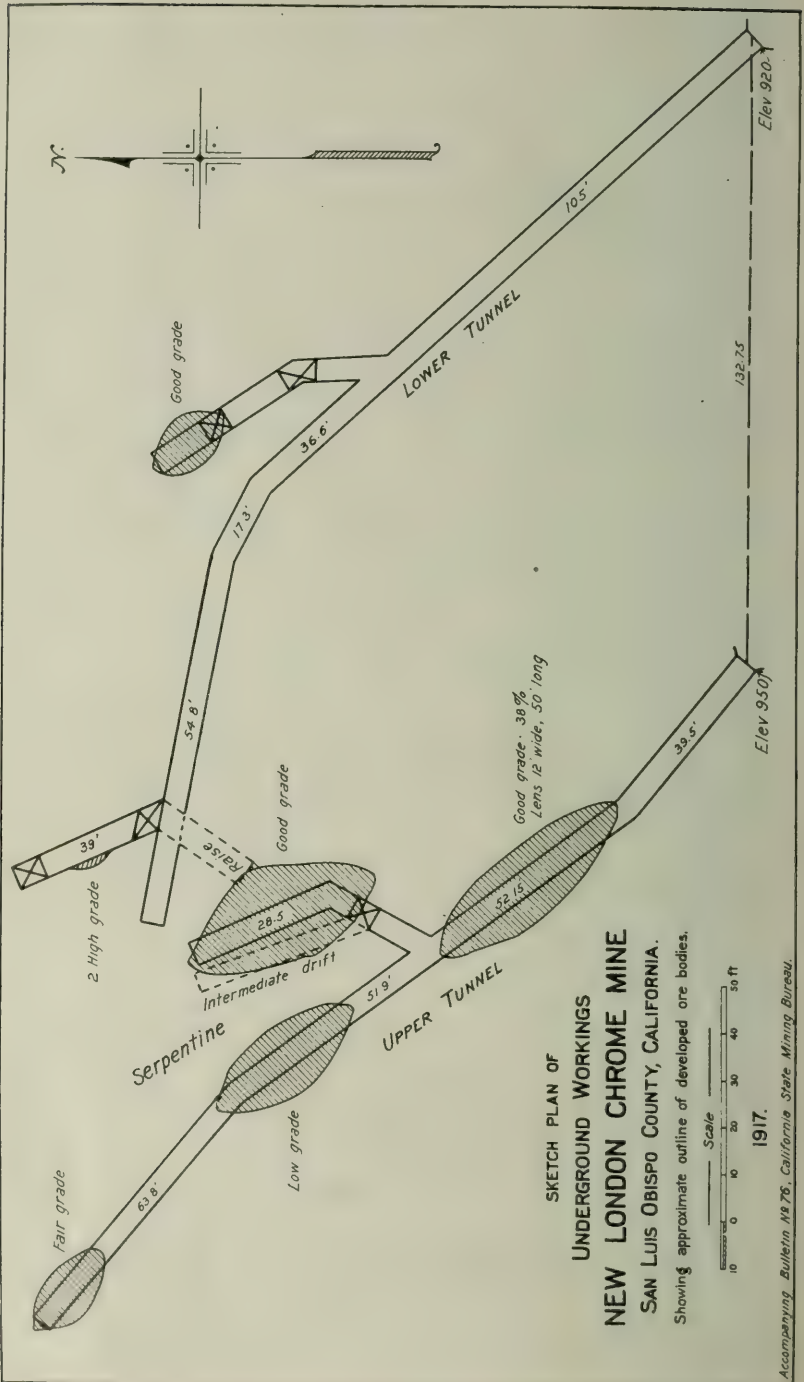
Lucky Jack Group, includes the Chrome, Lucky Davis, Lucky Chrome, Bonilla, Lookout and Flores claims. They are situated in Sections 29 and 31, T. 29 S., R. 12 E. This is on a ridge west of Tassajara Creek, at an elevation of 2000 feet, and about 4 miles west of Santa Margarita on the Southern Pacific R. R. A number of open cuts have developed some small stringers of low grade chrome, mixed with serpentine. To date no deposit of consequence has been opened on the property. S. Aumaier, San Luis Obispo, owner.

Middlemast Chrome Deposit. Twenty-five miles northwest of San Luis Obispo, and 4 miles east of Cayucos on the W. C. Middlemast Ranch, chromite has been found in small quantities as float and in small lenses in the serpentine. The deposit is in the north half of Section 25, T. 28 S., R. 10 E., at an elevation of 450 ft. above sea level.

Mutual Chrome Mine. This is a holding of 80 acres owned by Dibblee and Arata of San Luis Obispo. It lies west of and adjoins the Chorro Creek Mine and is situated in Section 35, T. 29 S., R. 12 E., $4\frac{1}{2}$ miles from Goldtree. No development work has been done on the property with the exception of several old prospect holes.

New London Chrome Mine is situated in the SW. $\frac{1}{4}$ of the SE. $\frac{1}{4}$ of Sec. 33, T. 29 S., R. 12 E., 6 miles northwest of San Luis Obispo, and three miles from Goldtree Station in a westerly direction. The principal workings are situated on the slope of a ridge northwest of a branch of Chorro Creek. There are two tunnels on the property. At

PLATE IV



SKETCH PLAN OF
 UNDERGROUND WORKINGS
NEW LONDON CHROME MINE
 SAN LUIS OBISPO COUNTY, CALIFORNIA.
 Showing approximate outline of developed ore bodies.

Scale 0 10 20 30 40 50 ft
 1917.

Accompanying Bulletin 118 76, California State Mining Bureau.

an elevation of 950 feet the upper tunnel was driven N. 51° W., and 40 feet from the portal encountered a lens of chrome with a strike of N. 36° W. and a dip of 60° NE. This lens of ore is 50 ft. in length with an average width of 12 ft. and ore shipped from the lens gave an average of 38% chromic oxide.

On this general course the tunnel follows leaders of chrome which run into two smaller lenses, 27 ft. and 14 ft. in length respectively, and about 8 ft. in width. The main tunnel level is 208 feet in length.

At a point 92 ft. from the portal a drift has been run N. 27° E., a distance of 67 ft., and a large lens of ore, 50 ft. in length and 25 ft. in width, developed. This large lens also dips 60° NE. At a point 19 ft. from the intersection of the drift with the main tunnel level, a raise has been made in the lens a distance of 20 ft. and a drift run NW. 40 ft. in the ore, thus giving an ore body 50 ft. long, by 25 ft. wide, by 20 ft. above the tunnel level.

At an elevation of 920 ft. and 133 ft. west of the upper tunnel, a lower tunnel has been driven NW. 214 ft., without developing any ore. At a point 105 ft. from the portal of the tunnel, a drift has been driven N. 10° W., a distance of 19 ft., where an incline raise 50 ft. in height was made, developing a small lens of chrome 6 ft. in width. From this raise a drift runs N. 30° W. for a distance of 20 ft., where a small lens of ore was cut and which was drifted on a distance of 16 ft., with a course N. 30° W. This lens is 16 ft. long and 6 ft. wide and of good grade ore. In the main tunnel level at a point 50 ft. west of the intersection of tunnel and drift, another drift bearing N. 30° W. has been driven a distance of 39 ft. From this drift an incline raise is being driven at an angle of 50° to develop the large lens of ore that has been opened up on the upper tunnel level. There is also a raise at the intersection of this drift with the main tunnel level, and both of these raises have developed ore. Quite a tonnage of fair grade ore has been exposed on the property, together with shipping ore, and a certain tonnage of low grade ore that could be concentrated. The lenses so far mined have a general northwest strike and a uniform dip of about 60° NE. With systematic development, a large tonnage of ore should be disclosed on the property. Two hundred tons per month are now being shipped from the mine. It is reported to average 38% chromic oxide, with 8 to 10% silica content. Fifteen men are employed. The ore is hauled a distance of three miles to Goldtree Station at a cost of \$1.25 per ton. The sketch map herewith shows the underground workings and ore bodies developed. Chas. Waters of San Luis Obispo is the owner. It is being worked under lease by Dibblee and Arata of San Luis Obispo, P. A. H. Arata, Mgr.

Norcross Chrome Mine. It is located ten miles northwest of San Luis Obispo in Section 13, T. 29 S., R. 11 E., on the southwest slope of the Santa Lucia Range. At an elevation of 1200 feet, there is an open cut 150 feet long by 150 feet wide and 50 feet deep. A number of small lenses of chromite were extracted from these workings in the past. The ore zone is about 150 feet wide, in which the chromite is impregnated throughout the serpentine, and has a general north and south strike. From samples taken from these workings, the ore bearing zone will carry about 15% chromic oxide.

The dump from this open cut contains 1000 tons of ore, carrying 15% chromic oxide. The ore from dump and open cut is being treated in a 50-ton concentrating plant. The ore is trammed to a 50-ton stor-

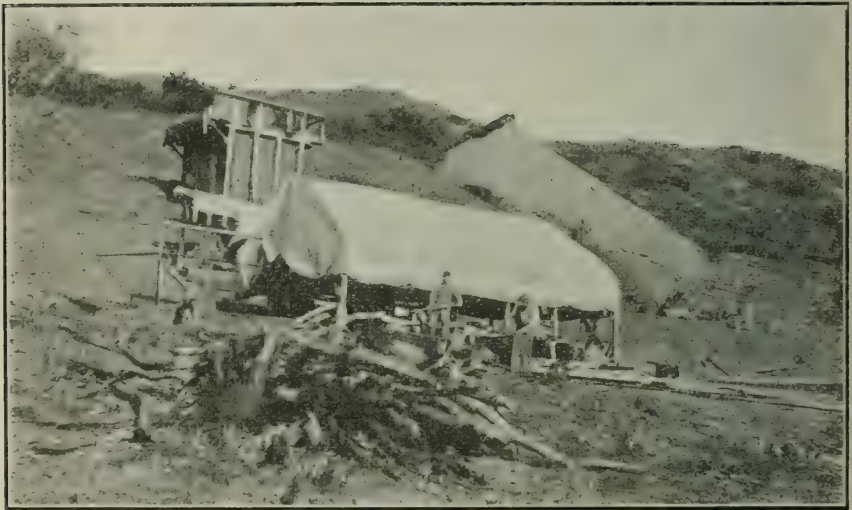


Photo No. 37a. Concentrating plant (50-ton) of Union Chrome Company, at Norcross Mine, San Luis Obispo County; showing dump, bins, and mill.

age bin, from which the ore is conveyed by belt conveyor to Ellis-Chili ball mill, and crushed through 20 mesh screen. The product from mill goes direct to hydraulic classifiers, and then to two Gates concentrators. The tables are producing about fifteen tons of concentrates running 44% chromic oxide. From the results obtained, it is planned to increase the capacity of the plant by the addition of another table. Twenty men are employed. Owner, E. Biaggini, Cayucos, Cal. Under lease to Union Chrome Company, offices, Adams Building, San Francisco, Calif.

Pick and Shovel Mine. This mine is located four miles north of San Luis Obispo on the western slope of the Santa Lucia Range, about half way to the summit. It contains 83.2 acres which are in the SE. quarter of Sec. 34, and the SW. quarter of Sec. 35, T. 29 S., R. 12 E.

This property was worked more extensively in the past than any chrome deposit in the district, and produced a large tonnage between 1880 and 1890. The old workings consist of 2500 feet of tunnels, the longest being 900 feet. It bears N. 60° E., and is driven at an elevation of 1840 feet. The ore occurred in lenses and stringers in a crushed zone. It has been stated that, from one lens of ore encountered at a distance of 560 feet from the tunnel portal, there was extracted 800 tons of chrome. The dip of the kidneys of ore was 30 degrees to the north-west. The chromite was found impregnating the serpentine as well as in almost pure masses. Recently the workings from this tunnel have been reopened, and some new lenses of ore developed. At a lower

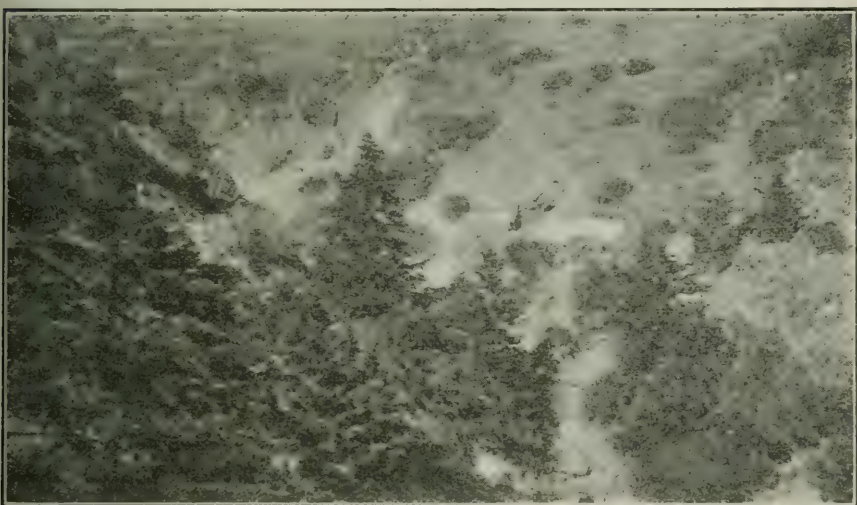


Photo No. 37. Pick and Shovel Chrome Mine, San Luis Obispo County.

level, another tunnel has been driven which has opened up a lens of chromite fifty feet in length by twelve feet thick, and fifteen feet deep, containing approximately 1000 tons, and it reported that the shipments made from this lens runs 50% chromic oxide. Twenty men are employed. P. A. H. Arata, et al, owners. Under lease to L. H. Butcher Co., 214 Front Street, San Francisco, F. W. McKee, Supt.

Pine Mountain Group. These locations cover what was formerly known as the Chisholm mine. About 400 tons of good chromite are said to have been produced here in the '80s, but work was suspended when the price of chromite fell to \$8. The ore came entirely from shallow trenches and off the surface. There are three claims which adjoin the Hearst Ranch in Sections 3 and 10, T. 26 S., R. 8 E. They are on the flank of Pine Mountain at an elevation of over 2000 feet and lie 11 miles from San Simeon, with a road across the Hearst Ranch to

within a mile of the claims. They were relocated in December, 1917, and January, 1918, by Joe Pereira of Cambria. Mr. J. A. Faucher recently bought one and leased the other two on a royalty basis. Subsequently, two of the claims, named the Lucky Strike and the Old Timer, were sold to Mrs. P. A. Hearst for \$1500.

The claims are in the serpentine near a contact with diorite. There has been a wide distribution of chromite over the claims, as indicated by the old trenches. There is a series of outcrops on the lower claim which indicates the presence of a good sized lens of ore, and there are also promising indications of ore in place farther uphill. Geological conditions are favorable for the development of a good producer, because of the proximity to the diorite-serpentine contact. Extensive mineralization appears to have occurred and early production may be reasonably expected.

Pereira Group. Joe and Pablo Pereira, Cambria, Locators, J. A. Faucher, Oakland, lessee. Consists of three claims located January, 1918, in T. 25 S., R. 8 E., three to four miles north of Pine Mountain by trail, and lying at an elevation of about 2500 feet. On the Beauty Spot claim two and one-half tons of fine grained, high grade ore was taken from a shallow trench in greenish clay, and this was all the chromite in sight, although there was a chance of more being found by following a well defined parting at the bottom of the trench. On the Potrero claim, a mile farther south, a few hundred pounds of ore have been dug out near the surface, but prospecting has failed to disclose even a stringer which might serve as an indication of other lenses. On the Red Rock Ocean View claim a small lens in place in serpentine has yielded about 20 tons of good ore and there are some stringers of chromite in the ends of the pit which amply justify further work, as they are apt to lead to other kidneys of ore which do not outcrop. This claim is the southernmost of the group. It is notable that conditions appear to become more favorable for the occurrence of chromite as one goes south along this serpentine zone. This last named claim, comprising 40 acres, was purchased March 19, 1918, by Mrs. P. A. Hearst for the sum of \$1000.

Rancho Piedra Blanca. On this ranch, owned by Mrs. Phoebe Hearst, of San Francisco, chromite is reported to occur, but no development of the deposits has been attempted. The property is located in Sec. 4, T. 25 S., R. 7 E.

Rancho Santa Manuela. A deposit of good grade chromite is found on this property, six miles northeast of Arroyo Grande, along the creek of the same name. T. Steele, Arroyo Grande, owner.

Rancho Santa Rita. Eight miles northeast of Cayucos, on this ranch, chromite of good quality is found on the surface. Some ore

was shipped from here between 1880 and 1890 but no mining has been done since.

Russ Deposit. On a ranch owned by Antone D. Russ in Sec. 4, T. 25 S., R. 6 E., a small deposit of chrome is being developed by the owner. It is stated that a good grade of chromite is being extracted.

San Carpojaro Creek and Arroyo La Cruz Deposits. Two claims known as the Owl #1 and Owl #2 have been located by Francisco J. Estrada and C. Marcel Garcia of San Simeon, Cal. These claims are situated in Sec. 12, T. 25 S., R. 7 E., on the divide between San Carpojaro Creek and Arroyo La Cruz. They are at an elevation of 2150 ft. and about eight miles north of San Simeon, and 30 to 40 miles southwest of Bradley, a station on the Southern Pacific Railroad. The chromite occurs in a serpentine belt which strikes N. 50° W. Along this belt considerable float ore is found and on the north slope of the ridge a small open cut has exposed an outcrop of massive chromite of good grade. The orebody is about five feet wide and the possibilities are that a large lens of ore could be developed. The inaccessibility of the deposit, due to the roughness of the country, and its distance from railroad transportation, makes it a difficult matter to get the material out, and no development, outside of assessment work, has been attempted.

Sweetwater Chrome Mine. Located in Sec. 12, T. 29 S., R. 11 E., approximately 17 miles northwest of San Luis Obispo, and five to seven miles northeast of Morro Rock in an air line. This group, also known as the Pierce and Benadom group, embraces the Chromic Acid, Chromic Acid Extension, Rocky Road, Last Hope, Sweetwater No. 1, No. 2 and No. 3 claims.

On the Sweetwater claims which lie on the northwest slope of the hill at an elevation of 1600 ft., a series of tunnels have been driven southeast, at different elevations, on a well defined fissure in the serpentine. At different points along the general strike of this fissure a succession of kidneys or chromite have been developed by this work. These kidneys of ore vary in size, but three well defined lenses have been opened up which have a length of 60 ft. and a width of from 4 to 6 ft. The general strike of the fissure is N. 60° W. with a dip of 60° to the northeast. On top of the ridge there is an open cut 60 ft. long which connects with a tunnel of equal length. These workings show two well defined lenses of ore of good quality. A cross-cut has been driven which cuts the lenses 30 ft. lower down. The surface workings on these claims extend for 100 ft. along the general strike of the fissure, and about 1000 tons of ore running 45% chromic oxide and 8% silica have been developed. The ore is hauled to Goldtree Station,

on the Southern Pacific Railroad, a distance of 18 miles at a cost of \$4.50 per ton. From 100 to 150 tons per month are being shipped and returns show the average of shipments so far made to be 46% chromic oxide.

The other claims have been somewhat developed by shallow open cuts and short tunnels and a small amount of ore has been uncovered. With systematic work a large tonnage of good grade chrome could be developed on these claims. Six men are employed. The property is under lease to Wm. Hollister of San Luis Obispo. W. W. Pierce, G. W. Benadom and Annie Pierce of Morro, are the locators and owners.

Welsh Ranch Deposit. On the Joseph C. Welsh Ranch, in Sec. 4, T. 31 S., R. 11 E., eight miles west of San Luis Obispo, a trench has uncovered a small lens of good grade chromite.

James Wheeler, and associates of Santa Margarita, have recently located a number of claims for copper and chromite along the summit of the Santa Lucia Range, extending about two miles along the ridge at a distance of four to seven miles south of Santa Margarita. Such of the ore as has been developed by shallow cuts, is rather low grade, being mixed with a good deal of serpentine, but the region is so hard to prospect that bodies of good ore might easily be present without having been found. About one and one-half miles from the Marquart Antimony Mine, on government land, massive chromite of good quality is reported to have been found, the largest boulders being about one ton in weight.

Zerfing Ranch Deposit. A deposit of chrome occurs on the property of Arthur L. Zerfing of Cayucos. The deposit is located five miles east of Cayucos in the SE. $\frac{1}{4}$ of Sec. 24, T. 28 S., R. 10 E., at an elevation of 500 ft. A streak of chromite, striking N. 60° E., and dipping to the south, crosses the Old Creek and Santa Rita Road. The vein varies in width from 8" to 2' and has been opened up along the strike for a distance of 60 ft. It is planned to drive a tunnel below the road which will give some depth below the open cut on the upper side, as the course of the vein is across the hill on the upper side of the road. About 10 tons of ore have been extracted, and reported to run 46% chromic oxide with 8% silica. The cost of hauling the ore to San Luis Obispo, the nearest railroad point, a haul of 25 miles, is from \$4.50 to \$5.00 per ton. The property is leased to E. J. Wear of Paso Robles, who is doing the development work.

Bibl.: U. S. G. S. Bull. No. 430. U. S. G. S. San Luis Folio No. 101. Cal. State Min. Bur., Report on Mines and Mineral Resources of San Luis Obispo County, 1916.

SANTA BARBARA COUNTY.

Santa Barbara County adjoins and closely resembles San Luis Obispo in geographic and geologic structure. Chromic iron deposits for which the latter county is noted are by no means absent from Santa Barbara, but they have not been extensively developed yet. Satisfactory production of chrome ore has been made during 1918, and there are attractive possibilities, especially in the San Rafael range.

Los Olivos Deposit. There is a deposit of chromite in the San Rafael range of mountains, 16 miles east of Los Olivos. The chromite occurs in a serpentine belt which strikes northwest and southeast about $\frac{1}{4}$ mile north of the Happy Cañon and Acachuma wagon road. This territory is included in the Santa Barbara Forest Reserve.

A number of years ago P. B. Montanaro of Los Olivos opened up a lens of chrome which strikes north and south, and by means of a shallow open cut extracted about 20 tons of ore, which still lies on the dump. In those days the price was too low to pay for hauling the material to the railroad, and, besides, in this instance, the lens mined was a small one and no other ore was developed. On the same ridge considerable float chrome was noticed and with further prospecting it is quite possible that other lenses of ore will be found in this locality.

La Laguna Ranch Chrome Deposit. The deposit is situated in the San Rafael Mountain range on the ridge between Figueroa and Corales Creek, at an elevation of 2500 feet. It lies on the north corner of the La Laguna Ranch about 1 mile southeast of the F. M. Tunnel ranch and 12 miles northeast of Los Olivos. A large amount of chrome float is found in the serpentine areas on the ridge and in the gulches. On the southeast slope of the ridge there are 7 large boulders of massive chromite which weigh about 1 ton each. Three of these boulders lie in a line with northwest and southeast strike, giving the impression that a large lens of chromite might be developed. The country where the chromite occurs is rough and almost inaccessible, which accounts for the deposit not being developed, as the cost of building a road to the property would be large. It is owned by the La Laguna Ranch Co., W. H. Bradley, Secy., 320 Chamber of Commerce Bldg., Pasadena, Cal.

O'Donnell and Burns Mining Co. of Santa Ynez, took a 5-year lease early in 1918 of mineral rights on 70,000 acres of land east and southeast of Los Olivos and Santa Ynez. Active prospecting by O'Donnell resulted in the discovery of lenses of high grade chromite, and production has continued since, a force of 30 to 40 men being employed at present (September, 1918). Six miles of new road had to be built. Ore so far shipped has come from points 12 to 15 miles southeast of Los Olivos, the rail point, and the haul is said to cost \$7 a ton. Mr. O'Donnell reports that none of the ore sold has carried less than 45% Cr_2O_3 and that the last three cars averaged 49%, 51% and 53% Cr_2O_3 .

respectively. One lens yielded 265 tons. At present a large lens is being mined by a drift, which has been driven 60 feet in ore. Development at this property is expensive, as the lenses of ore do not outcrop and considerable unproductive prospecting has been found necessary. The high grade of the ore makes a good profit possible, however, in spite of high costs. The operators expect to make a total production of about 1000 tons for 1918. Teams and one auto truck are used for hauling, the truck being kept in practically continuous service, day and night.

Pt. Sal. Deposits of chromite occur in the hills southwest of Pt. Sal, and in the San Rafael Mountains, south of Santa Inez. As these occurrences are small and inaccessible, they have never been developed.

Bibl.: Cal. State Min. Bur., Report on Mines and Mineral Resources of Santa Barbara County, 1916.

SANTA CLARA COUNTY.

Kilday Ranch Deposit. Several small lenses of chromite have been developed on this property which lies along the top of a ridge, probably 1000 feet in elevation above Guadalupe Cañon and eight miles southeast of Los Gatos. The ridge here is capped with a decomposed serpentine, and chromite has been found at several different places, but thus far no large deposit has been uncovered, and there is very little ore now exposed. About eighty tons of the ore was shipped out by the Farish Co., Insurance Exchange Bldg., San Francisco, during 1916, but no work has been done since. M. J. Kilday of Los Gatos is the owner.

Laurel Lake Ranch Deposit. J. A. Ferbrache of Gilroy, is developing a deposit of high grade black chromite on his property seven miles northwest of Gilroy. The serpentine in which the chrome ore occurs outcrops prominently along the ridge south of Uvas Creek. Associated with the serpentine is a peridotite, thin sections of which have been examined microscopically and show phases high in olivine, and also approaching augite pierite. Although still retaining its original outlines, much of the olivine is seen to be altered to serpentine. One large boulder was uncovered in the loose soil capping and a tunnel is being driven to cut some leaders which occur in the serpentine above. There have been some shipments since the property was visited.

Winship Properties, K. D. Winship, #350 Post Street, San Francisco, owner; C. W. Rose and M. J. Gates, lessees, #211 Pacific Street, Santa Cruz. Chromite occurs on Sec. 11, T. 6 S., R. 4 E., and on SW. $\frac{1}{4}$ Sec. 7, T. 6 S., R. 5 E., M. D. M. Holbrook and McGuire, as sub-lessees in the summer of 1917, shipped several earloads of high grade chromite from this property.*

*Since the above was written, T. & S. O'Brien et al., 75 Fremont St., San Francisco, have leased this Sec. 11, and are building a 50-ton concentrating mill (September, 1918).

SHASTA COUNTY.

In the northwestern corner of Shasta County there is an area in which serpentine and basic igneous rocks more or less altered to serpentine occur abundantly. They are contained within the area mapped by Smith¹ as "Paleozoic metamorphics undifferentiated: including limestones, slates and associated igneous and metamorphic rocks of the Klamath Mountains," which extends from near Lamoine, northeasterly to and beyond Dunsmuir. Though this metamorphic area appears on both sides of the Sacramento River north of Gibson, no serpentine nor chromite have as yet been reported east of the river. From the northern end of this serpentine belt has come the second largest single lens of chromite thus far developed in the United States. From the Little Castle Creek mine on the creek of the same name near Dunsmuir, on the Shasta-Siskiyou County line, the records of the State Mining Bureau show that upwards of 15,000 tons of chromite were shipped from 1900 to the end of 1916. Much of the chromite in this district is massive and high grade, but some disseminated orebodies have been noted in at least one locality.

Andrews Claim. Asa E. Andrews, Lamoine, in June, 1917, was developing a chrome prospect northwest of Lamoine, but the Bureau has no data to hand as to whether any shipments of ore have as yet been made.

Davis Group. (Including Sunshine Claim of Davis and Miller in Sec. 13; and the Live Oak claim of Davis in Sec. 24.) J. A. Davis, Hazel Creek, post office, and San Rafael, has claims located on a government 40 A. in Sec. 13, T. 37 N., R. 5 W., M. D. M., also in Sec. 24, and a lease on railroad land in portions of Secs. 13, 23 and 25 in the same township. In June he had taken out a small tonnage of medium grade chromite ore; but had not as yet made any shipments, which would go via wagon road to Sims station (Hazel Creek, post office) on the main line of the Southern Pacific Railroad. It is stated that some ore was shipped from this Sec. 13 several years ago. Some sericite and chromium chlorite are associated with the chromite.

Deick Claims. Walter Deick, Hazel Creek, has locations on a chromite prospect west of Sims station.

Forest Queen and Gray Eagle Chrome groups. Union Chrome Company, owner, #180 Sutter Street, San Francisco; E. A. Wiltsee, President and Manager. These properties on Boulder Creek, west of Gibson siding, were bought in 1916 from the locators, by the above named company, who operated quite extensively during that year. The Forest Queen Mine is in the NW. $\frac{1}{4}$ of Sec. 22, T. 37 N., R. 5 W., M. D. M.

¹Smith, J. P., Geological map of California, accompanying The geologic formations of California: Cal. State Min. Bur. Bull. No. 72, p. 9, 1916.

Irregular shaped ore bodies occurring in peridotite have been opened by inclines and tunnels. The main workings consisted of a 50' cross-cut at an elevation of 4420', to an orebody striking N. 40° E. and pitching 45° NW. The ore had been stoped for 150' in length and 100' in depth. The body varied from 0'-4' in width. The stopes are connected by a 60' incline shaft just west of the tunnel entrance.

At an elevation of 4450' is a 50' tunnel with a 16' incline showing ore from 12" to 18" wide and from 6' to 10' high. The ore appeared to run about 50% Cr_2O_3 .

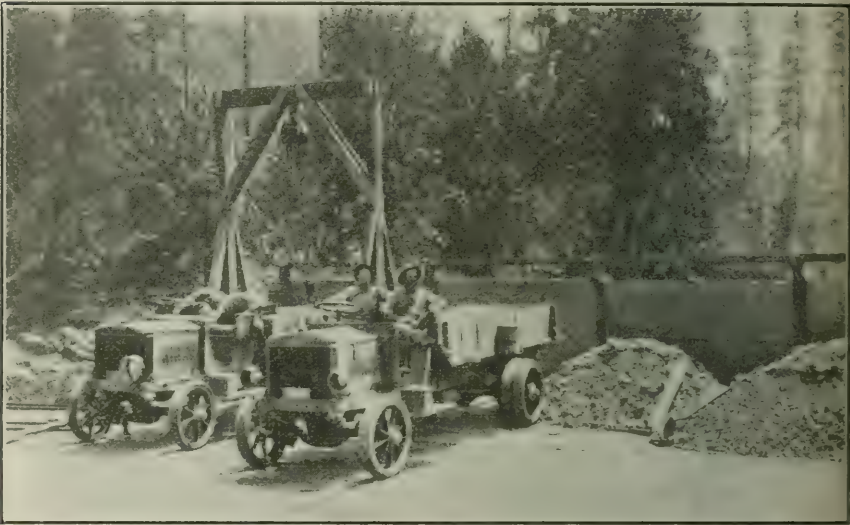


Photo No. 38. Trucks at Gibson Siding hauling chromite ore from the Forest Queen Mine, Shasta County.

The Jumbo, or lower tunnel, at an elevation of 4400', had been run N. 33° W. for a distance of 135'. A drift on the 30' level had been run east for 15' and one on the 40' level had been run east for 25'. Only about 15 tons of ore were said to have been taken from the first drift and none from the second.

The ore from the different workings was dropped to the tram level, at an elevation of 4300', in a 150' incline chute. About 1000 tons of ore averaging 43% Cr_2O_3 and 5 to 6% SiO_2 were reported to have been produced from the property, 100 tons of which were shipped in 1917.

Gill et al. had a small tonnage of medium-grade chromite on the freight platform at Gibson siding north of Lamoine, shipment of which it was stated was being held up on account of litigation. This ore came from a deposit on Shotgun Creek about a mile above the Sacramento River.

Grafton Claim. George Grafton, Lamoine, is reported to have a chrome prospect eight miles northwest of Lamoine.

Hearst Property. Mrs. Phoebe A. Hearst, Hearst Building, San Francisco, owner; F. J. Solinsky, Jr., lessee, #729 New Call Building, San Francisco. Some ore has been shipped by the lessee from lenses opened up on land owned by Mrs. Hearst, southwest of Dunsmuir, and near the Little Castle Creek properties. From two to eight men were employed. Hauling to the railroad is done with teams.

Hoy Claims. E. K. Hoy, Dunsmuir, in June had 2 men at work developing a chromite prospect on Sec. 15, T. 37 N., R. 5 W., three miles south of west from Sims. The chromite is massive and apparently high grade. Hauling would be done via Gibson.

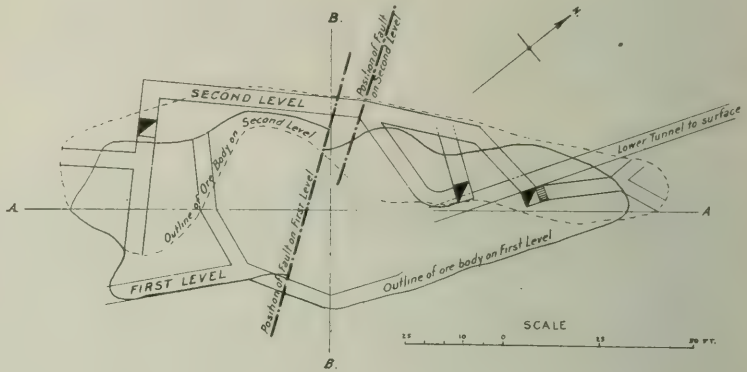
Ida Chrome Group. Locations in this group on Sec. 25, T. 37 N., R. 5 W., M. D. M., on Campbell Creek near Sims are stated to have lapsed and are now included in the Davis group (see *ante*.)

Little Castle Creek Mine (formerly also known as the **Brown Mine**), California Chrome Company, owner; E. F. Price, president, Forty-second St. Building, New York, N. Y.; Geo. H. Lindsay, assistant secretary; J. B. Huffard, vice-president and manager, Kohl Building, San

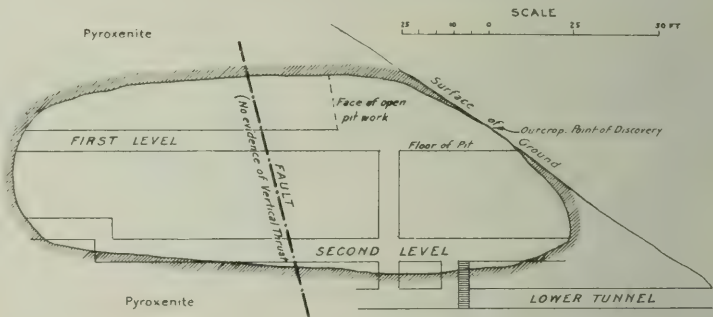


Photo No. 39. Edge of caved ground at surface of Little Castle Creek Mine, after extraction of the ore by caving system.

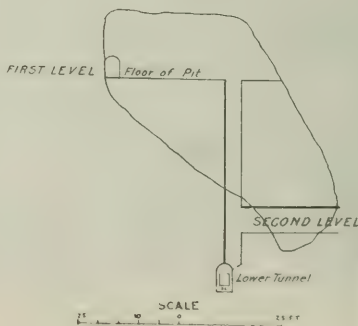
(a) Plan



(b) Longitudinal Section through A-A.



(c) Transverse Section through B-B



CALIFORNIA STATE MINING BUREAU
 SECTIONS OF CHROMITE DEPOSIT
 ON
 Little Castle Creek
 SHASTA CO. CAL.

Francisco. This property is in Sec. 2, T. 38 N., R. 4 W., about three miles south of west from Dunsmuir, on the ridge on the south side of Little Castle Creek, and on the Shasta-Siskiyou county line. Most of the ore has come from the Shasta side of the line. The claims were located in 1906 by L. H. Brown of Dunsmuir, who operated them more or less continuously up to July, 1915, when he sold to the present owners.



Photo No. 40. Aerial tramway at Little Castle Creek Mine of the California Chrome Company, Shasta County.

This deposit has yielded the largest tonnage of any single lens or segregation of chromite yet developed in the United States (except one at Lancaster, Pa., early in the 19th century), the records of the State Mining Bureau showing a production of approximately 15,000 tons to the end of 1916.

The lens apexed at the surface and Brown worked it through adit crosscuts and stopes. The present owners drove a lower crosscut, which

bottomed the lens, through to the farther wall of the ore body; then stoped the ore out by adopting a system of allowing the ground to cave behind them. The effect of this at the surface is seen in part in Photo No. 39. Amphibole asbestos is associated with the orebody on one wall and a talc gouge up to 2' thick on the other wall. On the asbestos side some disseminated ore occurs. Outside of the talc gouge the country rock is an enstatite peridotite in part altered to serpentine. Occurring in vesicles or vugs in the chromite, in places were found some beautiful wine-colored crystals of the chromium chlorite mica (kammererite or kotzchubeite.)



Photo No. 41. Ford-motor locomotive and train (30" guage) for hauling chromite to main-line railroad, by California Chrome Company, near Dunsmuir.

The following description and accompanying drawings are taken from a recent report by Diller¹ from material furnished through the courtesy of Mr. J. R. Van Fleet, engineer in charge for the California Chrome Company:

"The ore body on the first mine level is 146 feet long in a direction N. 40° E. and 40 feet wide, with a height of 54 feet. On the second mine level 30 feet below, the length increased to nearly 160 feet but decreased by half in width and thickness.

"The country rock of the chromite ore body is in part peridotite but chiefly pyroxenite, which exhibits large cleavage surfaces often several feet in extent. These cleavage surfaces are sometimes spotted with grains of olivine, giving the surface a decidedly greenish color. Along the east wall the pyroxenite has been altered into serpentine, which gradually merges into the parent rock in a few feet. On the south

¹Diller, J. S., Chromite in 1916; U. S. G. S., Min. Res. of U. S., 1916, Part I, pp. 28-30, 1917.

end of the ore body there was a mass of heavy black rock, probably dunite, which to the uninitiated was easily mistaken for chromite. Along the east wall there was a decided line of cleavage between the ore and the wall, the ore coming away freely and clean; while on the west side there was no line of demarcation, the ore grading off into the wall rock and often large masses of the wall rock intruding into the ore body. This same occurrence also existed on the top 10 feet of the south end. The ore body was characterized by numerous seams throughout. These seams were filled with a clay gouge containing fine particles of chromite and olivine, were from the thickness of a knife blade to several inches in width, and the surfaces of the chromite adjacent were smooth but showed no striations due to faulting. There was no system of these seams apparent except that they were generally wedge-shaped, always with the large end down, making the ore exceedingly heavy and hard to hold with timbers. There was one well-defined fault, which penetrated the ore body about through its center of mass in a northwesterly direction, and like the ore body dipped to the northeast about 75° . The position of this fault is shown at both levels on the plan of the deposit submitted. No evidence of any vertical throw was found, but there was a transverse or horizontal throw of about 5 feet on the first level. On the second level there was no throw observed. Along this fault plane there was a zone of about 4 feet in thickness of muddy clay containing fragments of chromite from fine particles to several hundred pounds in size. The walls of the adjacent chromite were smooth."

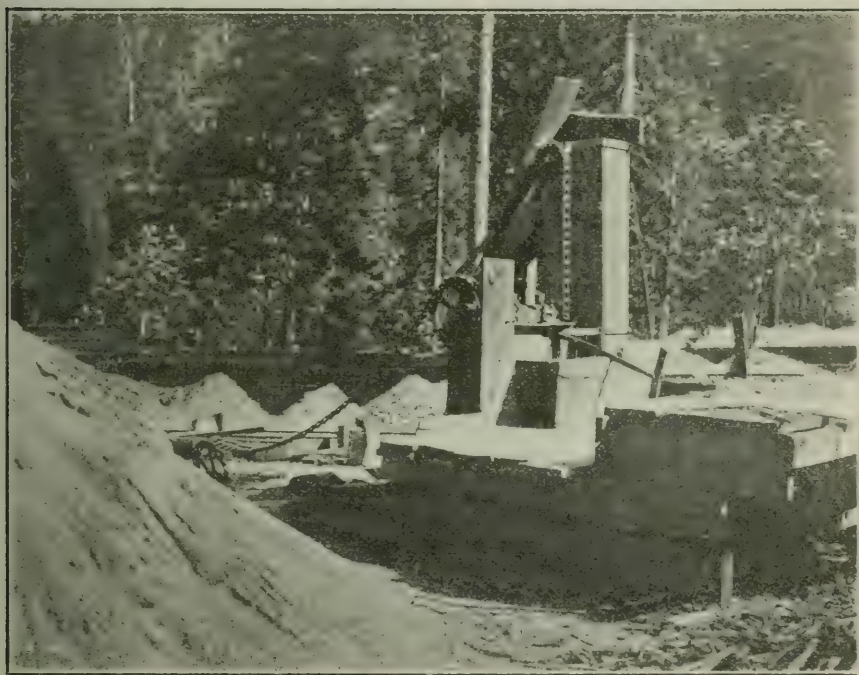


Photo No. 42. Jig used for concentrating low-grade chromite at Little Castle Creek Mine of California Chrome Company, Shasta County.

The shipping ore averaged 45%–48% Cr_2O_3 . An aerial tranway 1600' in length (see photo No. 40) transported the ore from the mine to the loading bunker at the creek, whence it was hauled over a 30-inch gauge railroad one mile to the main line of the Southern Pacific, south of Dunsmuir. A Ford-motor locomotive, geared down, furnished the power (see photo No. 41) and side-dump cars were used. The operating cost for oil and gasoline is stated to have been \$1.00 per day for hauling 50 tons, the distance of one mile. The topography is very steep, the elevation at the creek level being 3000' (U. S. G. S.), and approxi-

mately 4000' at the upper terminal of the tram. A jig (see photo No. 42), such as is used at the electric smelter at Niagara Falls, New York, for cleaning ferro-chrome slag, was being used to concentrate low grade and disseminated ore from the waste dumps. This jig handled 10 tons per 8 hours, and was driven by attaching a lower-gear wheel to the drive shaft of the Ford locomotive, above-mentioned. The sand (hutch) concentrate assayed 38% Cr_2O_3 , and the coarse concentrate 43%. Being a large orebody and favorably situated, mining and transportation costs were here much lower than the average obtaining for chrome mining in California. While this main lens appears to have been worked out, it is thought that further development work may yet reveal others, as there are others in the same belt nearby.

Bibl.: Mines & Mineral Res. of Shasta et al. counties, p. 11, 1915; also in Report XIV, p. 755, 1916. U. S. G. S., Min. Res. of U. S., 1916, Pt. I, pp. 28-30.

Lone Pine Claim. E. A. Curtis has a claim located on a chromite prospect in Sec. 13, T. 37 N., R. 5 W.

Miles & Westover Claims. D. E. Miles, #1515 Lafayette street, Alameda, and Wm. Westover, Hazel Creek, have claims located on chromite prospects in Secs. 14 and 34, T. 37 N., R. 5 W., near Sims station.

Miller Claims. Fred Miller et al., Hazel Creek, have a group of four or five claims located on chromite prospects near Gibson siding, and some ore has been shipped this year.

The **Noble Electric Steel Company** (formerly Priem & Dougherty group; also known as Shotgun Creek Mines) #995 Market Street, San Francisco, has two patented claims in Sec 24, and one in Sec. 13, T. 37 N., R. 5 W., on Shotgun Creek south of west from Sims station. Several years ago when these claims were operated by the former owners, a total of approximately 3000 tons¹ of chromite was shipped for use in furnace bottoms at a number of copper smelters in several western states, particularly at the Bully Hill and Keswick smelters in Shasta County. The ore is massive, high-grade chromite, occurring in irregular lenses in serpentine. The present owners have reopened these mines and resumed shipments in 1917.

Bibl.: Bull. 38, pp. 270-271, 1906; Mines & Mineral Res. of Shasta et al. counties; p. 11, 1915; Report XIV, p. 755, 1916.

Shotgun Creek Mines—See Gill: also Noble Electric Steel Company.

Sperry Prospect. P. and Clarence Sperry, Lamoine, have a chromite prospect on Shoemaker Mountain near Lamoine.

¹Forstner, Wm., et al., Structural and Industrial Minerals of California: Cal. State Min. Bur., Bull. 38, p. 271, 1906.

SIERRA COUNTY.

The **Camptonville** chrome property is six miles northeast of Camptonville on the road to Brandy City. Chrome ore occurring in serpentine was mined and hauled to Oroville. About 180 tons of ore, averaging over 45% Cr_2O_3 are said to have been shipped in the fall of 1916.

The **Gibsonville** chrome property is in Sec. 29, T. 22 N., R. 10 E., M. D. M., two miles east of Gibsonville, at an elevation of 5800'. It includes five claims called Chrome Nos. 1, 2, 3, 4 and 5, owned by W. T. Baldwin of Oroville, and Leon Cluff and G. W. Chamberlain of Quincy.

Bodies of chrome ore occur in serpentine and peridotite. The workings on No. 1 claim are 300' west of the road to Howland Flat, on the east side of Slate Creek at an elevation of 5300'. An orebody striking east-west and pitching 85° south had been open cut 10' deep and 16' long on the west face of the hill. The deposit looked as though it might open out if followed eastward into the hill. Approximately 20 tons of ore had been corded for shipment.

Development work on No. 2 claim had been done on a ridge NE. of Gibsonville above the road to Howland Flat. A lens of chromite 4' wide, 5' deep and 10' long had been mined, which struck N. 45° E. and pitched 80° NW. About eight tons of 38-40% ore had been piled for shipment.

A claim owned by Leon Cluff on the southeast slope of the same hill, had yielded 35 tons of 45% ore. The chrome occurred in form of a chimney, 6' by 8', which narrowed at a depth of 10 feet.

An assay of ore taken from the three claims is said to have averaged over 40% Cr_2O_3 . Three men were employed.

SISKIYOU COUNTY.

The districts in Siskiyou County in which chromite has so far been developed commercially are in the vicinity of Callahan, Etna Mills, Fort Jones, Yreka and Gazelle. In addition, occurrences as yet undeveloped have been noted near Hamburg and west of Sisson. These are found in disconnected areas of serpentine all of which appear to be within the areas mapped by Smith¹ as "Paleozoic metamorphics undifferentiated; including limestones, slates and associated igneous and metamorphic rocks of the Klamath Mountains." So far as developed, the best grade of ore in this county has come from the Callahan district, where the chromite occurs more in the massive form and in larger lenses. The writer also noticed that in the Callahan district the alteration of the original peridotites to serpentine seems not to have proceeded to as advanced a stage as in the districts to the north. In the region about Yreka, particularly, considerable sericite and chromium

(¹) Smith, J. P., Geological map of California, accompanying, The geologic formations of California: Cal. State Min. Bur., Bull. No. 72, p. 9, 1916.

chlorite with some chrome ochre are associated with the chromite. At Callahan the principal associated secondary mineral is the green chrome-garnet, uvarovite, some beautiful crystals of which were obtained by the writer at The Chrome Mine of Alonzo Bingham, southwest of Callahan. Geologically, the Coggins mine on Little Castle Creek south of Dunsmuir belongs with the district north from Lamoine in Shasta County¹ though this one mine of that belt is on the Siskiyou side of the county line.

The railroad shipping point for the Etna Mills and Fort Jones districts is Yreka, which is the terminus of the Yreka Railroad connecting with the Southern Pacific at Montague. The deposits are from 15 to 35 miles from Yreka. Ore from the Callahan district reaches the Southern Pacific Railroad at Gazelle, which is 28 miles from Callahan.

Bibl.: Cal. State Min. Bur., Bull. 38, pp. 272, 363; Report on Mines and Mineral Resources of Shasta et al. counties, p. 72, 1915; Report XIV, p. 816, 1916.

Ball Ranch, Mrs Ball, owner, Etna Mills; G. S. Marks, lessee, Etna Mills. From this prospect in Sec. 16, T. 41 N., R. 9 W., M. D. M., near Etna Mills, the lessee had, when visited in May, 1917, shipped a few tons of medium-grade chromite from two small open-cuts. The lenses of ore appear to be small.

Bingham's Mine. See **The Chrome Mine.**

Burns Ranch (formerly **Harris Ranch**). W. L. Burns, owner, Gazelle. Patented. This is on Willow Creek, in Sec. 16, T. 42 N., R. 6 W., M. D. M., four miles west of Gazelle. The Shasta River irrigation ditch passes through the ranch a few yards below the chromite deposit. The lens so far as developed is flat-lying and small, and there is also some disseminated chromite in the serpentine surrounding the main orebody. One carload of ore was shipped in 1916 by lessees, a portion of which is stated to have analyzed 56%, but most of the material in sight when visited by the writer was of only medium grade. There is still some loose float scattered over the hillside in the vicinity, so that there may be other lenses not yet uncovered. About one-fourth of a mile to the west of the chrome ore is an occurrence of chrysotile asbestos, in which a shallow, prospecting cut has been made. The material is somewhat hard and brittle, but fibres up to one and one-fourth inches were noted.

Butcher Hill Deposits. Messrs McNulty and Wurster of Yreka, each own 40 acres on what is known locally as "Butcher Hill" about one mile east of town. On the east side of the hill on the Wurster ground there is an open cut from which a few tons of medium to low-grade

¹See p. 181, *ante*.

chrome ore have been dug, but none shipped. At least three small lenses had been uncovered. The chromite is mixed with black serpentine and sericite. There is a body of limestone on the northwest side of the hill apparently in contact with the serpentine. In a saddle at the west side of the hill, on the McNulty ground a shallow shaft had been sunk in the serpentine, and about two tons of a fair quality of chromite found. It was characterized by veins of the green chrome-chlorite. The railroad passes within one-fourth mile of these deposits.

Coggins Deposit. Arthur L. Coggins, owner, Dunsmuir. This deposit is three miles south of west from Dunsmuir, on the opposite

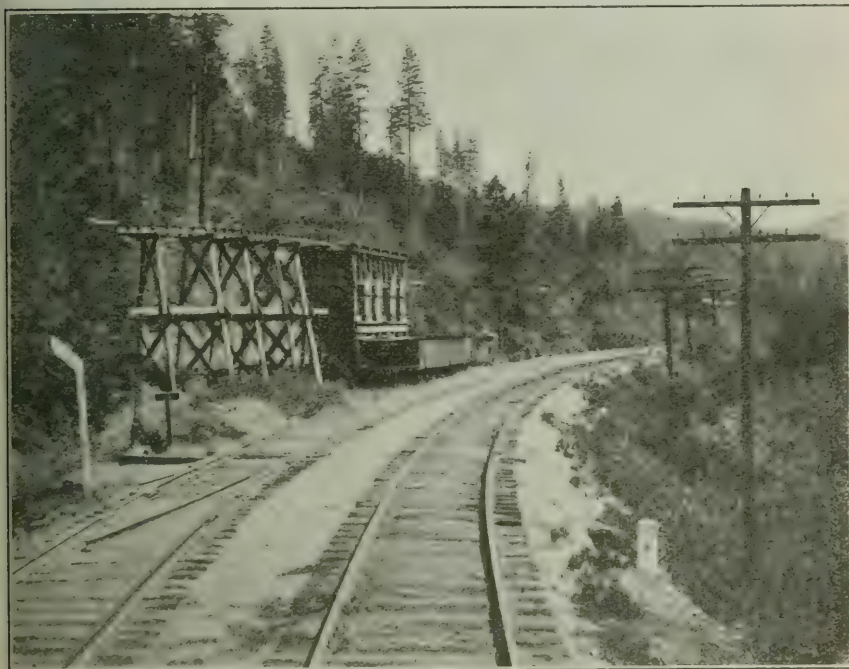


Photo No. 43. Loading bunker for chromite ore at Little Castle Creek near Dunsmuir, for the California Chrome Company and Coggins mines.

(north) side of the cañon and one-third of a mile below the Little Castle Creek mine of the California Chrome Company,¹ which is mainly on the Shasta side of the Shasta-Siskiyou County line. The ore is transferred by an aerial tramway from the workings on the steep mountain-side to a loading platform beside the narrow-gauge tracks of the California Chrome Company, whence it is hauled to the bins on the Southern Pacific main line (see Photo No. 43). The chromite occurs both massive and disseminated in the peridotite noted in the description of the

¹See p. 183, *ante*.

neighboring property across the cañon. The average grade of the first 1000 tons of ore shipped by Coggins was 40% Cr_2O_3 ; but it had to be hand-picked to maintain the grade. He reports the following analysis of a representative sample:

Constituent.	Per cent.
Cr_2O_3 -----	38
MgO -----	20
SiO_2 -----	12
Al_2O_3 -----	9
FeO -----	19

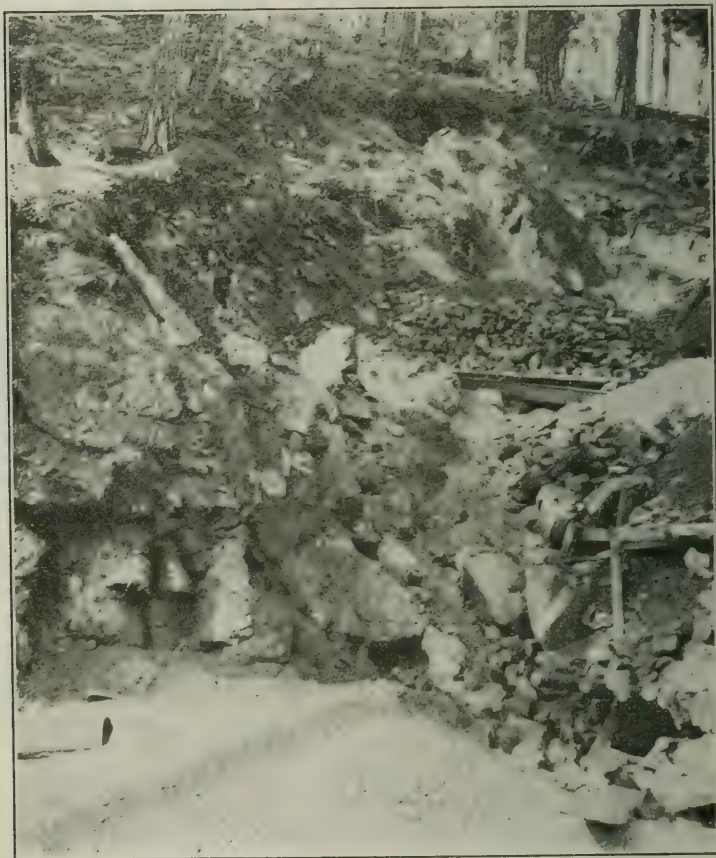


Photo No. 44. Upper working of Coggins Chrome Mine on Little Castle Creek, near Dunsmuir, Siskiyou County.

The deposit was being worked on two levels, and of approximately 1500 tons shipped previous to June, 1917, nearly all was from the upper cut and adit. (See Photo No. 44.)

In the lower cut another lens of apparently higher grade material was being opened up when visited. In the disseminated ore at the upper

workings, the small nodules and segregations of chromite average about $\frac{1}{2}$ inch in diameter to $\frac{3}{4}$ inch long. At the surface where the ferromagnesian minerals have weathered to a red soil, these chromite nodules from an aggregate resembling beans, and it is known locally as 'bean' ore. (See Photo No. 45.) Coggins stated that tests were being made toward concentrating this material, as a sample of the washed nodules had shown an analysis of over 40% Cr_2O_3 .



Photo No. 45. 'Bean' ore, at Coggins Chrome Mine, showing effect of weathering on disseminated chromite ore.

Cramer Ranch, Chas. Harris, owner; Edward F. Harris, lessee, Etna Mills. This prospect is in Sec. 22, T. 44 N., R. 8 W., M. D. M., on a branch of Scott River near Fort Jones and about 14 miles from Yreka. The lessee was developing a lens of chromite in serpentine, and had taken out a few tons of medium grade ore. He reported that he had found chromite also on the SW. $\frac{1}{4}$ of SW. $\frac{1}{4}$ of Sec. 23, T. 44 N., R. 8 W., and had applied to the Southern Pacific Railroad Company, the owner, for a lease.

Chromite Group, J. F. Dwyer, owner, Yreka. This group of 13 claims, designated as Chromite #1-#13 inclusive, is in Secs. 15, 22 and 23, T. 46 N., R. 11 W., M. D. M., three miles west of Hamburg on the north

side of the Klamath River, and 48 miles from the railroad at Hornbrook. It is on the opposite side of the river from the county road. The deposit was found by an Indian in 1912, but development work was only begun the past summer. The property was not visited by the writer, but Dwyer reported that both massive high-grade chromite and a large body of low-grade disseminated ore occur. The latter resembles the 'leopard ore' described at the Pilliken mine in El Dorado County.¹ It is proposed to concentrate this material. The country rock is an altered peridotite. The orebody is exposed 20 feet wide at the surface and is traceable for a length of 1200 feet. An 18-foot shaft has been sunk (December 3, 1917) on high-grade ore, and a cross-cut tunnel is stated also to have cut the ore at 30 feet below the surface. An aerial tramway could readily transfer the ore across the river to the county road, from which point Dwyer estimates that the haul of 48 miles to Hornbrook can be made with motor trucks at a cost of 25¢ per ton-mile.² Dwyer also has a bond on a group of chrome claims on the south side of Eddy Mountain, southwest of Sisson. About six miles of wagon road will have to be built before shipments can be made.

Davis Prospect, H. L. Davis, owner, Callahan. This claim located in May, 1917, is on the western side of Blue Jay Meadows, in Sec. 10 (?), T. 39 N., R. 9 W., M. D. M., about 10 miles from Callahan. Elevation, 6000 feet. It is about a mile west of Bingham's mine; and development work was just starting on a small outcrop of high-grade chromite, when the district was visited by the writer late in May. There was still some snow on the ground at that time.

Dexter Ranch, Geo. Dexter, owner, Montague. A deposit of chromite on this ranch, four miles west of north from Montague, was opened up under lease by C. F. Dougherty of Porterville in 1916 and several carloads shipped. The ore occurred in a series of small lenses in serpentine more or less connected, and was worked by an open cut and drift (see Photo No. 46) about 50 feet long. The ore shipped aver-

¹See p. 140, *ante*.

²Since the above was written, S. H. Dolbear of San Francisco has taken over operation of this property (also referred to as the Klamath Chrome Mine). A bridge has been built over the Klamath River, and ore shipments began in July, 1918. (See *Min. & Sci. Press*, Aug. 24, 1918, pp. 252-253).

aged 36% Cr_2O_3 . The crystal aggregates of the chromite are somewhat separated and surrounded with partings of sericite mica, an alteration product from the serpentine. It was stated that the property would be reopened this year (1917) by the Union Chrome Company of San Francisco, as lessee.

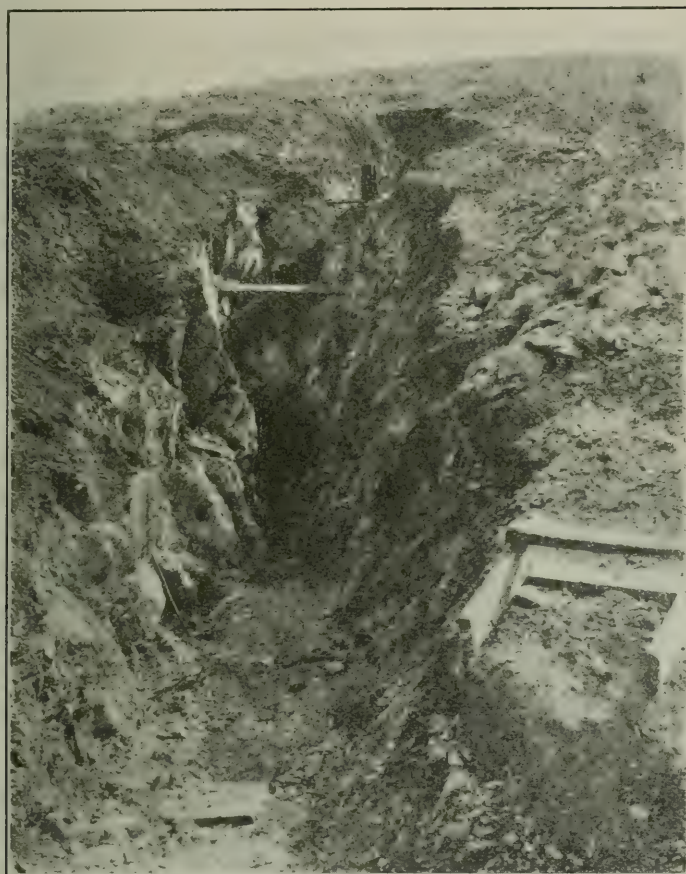


Photo No. 46. Chromite workings on Dexter Ranch, near Montague, Siskiyou County.

Dozier Deposit, Mr. Dozier, owner, Los Angeles; Noble Electric Steel Company, lessee, #995 Market St., San Francisco; C. F. Dougherty, superintendent at mine. This is 12 miles from Gazelle, on agricultural patented land in Sec. 2, T. 41 N., R. 7 W., M. D. M., on the north side of the basin at the head of Scott Creek, and about one mile southeast of where the Gazelle-Callahan road crosses the summit of the ridge. A lens of chromite in the serpentine was opened up here in 1900 and 247 tons of high grade ore shipped. The old cut was 8' wide and 15'

long, and partly caved. When visited, a little ore was being taken out from the edges of the old cut and an adit being driven to get under it.

Bibl.: Cal. State Min. Bur., Bull. No. 38, p. 272; Rep. on Mines and Mineral Res. of Shasta et al. counties, p. 72, 1915; Report XIV, p. 816, 1916.

Dwyer Group. See **Chromite Group.**

Flederman Claims, A. G. & R. Flederman, et al., owners, Yreka. This claim located in 1917, is in the S. $\frac{1}{2}$ of SW. $\frac{1}{4}$, Sec. 10, T. 41 N., R. 9 W., three miles from Etna Mills, and adjoins the Marks lease on the Ball ranch. The chromite occurs in small lenses in serpentine. When visited, one man was working and had taken out a few tons of ore from an open-cut. The ore was sledded one-half mile to the auto-truck road. Flederman also reports having made locations on a new find of chromite in Secs. 4 and 8, T. 43 N., R. 8 W. Specimens of the ore submitted to the writer appear to be of medium grade.

Flederman Leases, R. and A. G. Flederman, Yreka; W. H. Gassoway, et al., Fort Jones; have leases on chromite deposits on the Lighthill, King and Sharpe ranches near Fort Jones, in the hills on the



Photo No. 47. Chromite sacked, ready for shipment, from the Lighthill Ranch, near Fort Jones, Siskiyou County. About 10 tons of ore came from this lens.

east side of the Scott River Valley. The Lighthill ranch is in Sec. 28, T. 43 N., R. 8 W., M. D. M. The chromite lenses are in serpentine, and are worked by open cuts. These lenses were all small, the largest one on this ranch up to the time visited having yielded 10 tons of chromite (see Photo No. 47). The ore is sledded down the hill to the auto-truck road. A 3½-ton Packard truck makes two round trips daily to Yreka. The Frank Sharpe ranch is to the north of Lighthill's, and the Antone King ranch is next east of Sharpe's. On both of these, promising chromite prospects have been found, and preparations were being made at the time of the writer's visit, to begin development work. On some of the Lighthill ranch chromite, a white efflorescence appeared after exposure to the weather for a few days. A qualitative analysis showed this white material to be hydromagnesite, doubtless derived from the serpentine mixed with the chromite. The ore shipped is stated to have assayed 47% Cr_2O_3 .

Grant Chrome Prospect, Southern Pacific Railroad Company, owner; J. M. Grant, lessee, Etna Mills. The lessee was preparing to start development on a chromite prospect in Sec. 25 (?) T. 42 N., R. 9 W., M. D. M., two miles east of Etna Mills, and near the county road. The writer picked up some high-grade float on this prospect.

Grouse Creek Chrome Mine, E. C. Latchem, owner, via Gazelle or Callahan. This is on a patented placer gold property at the junction

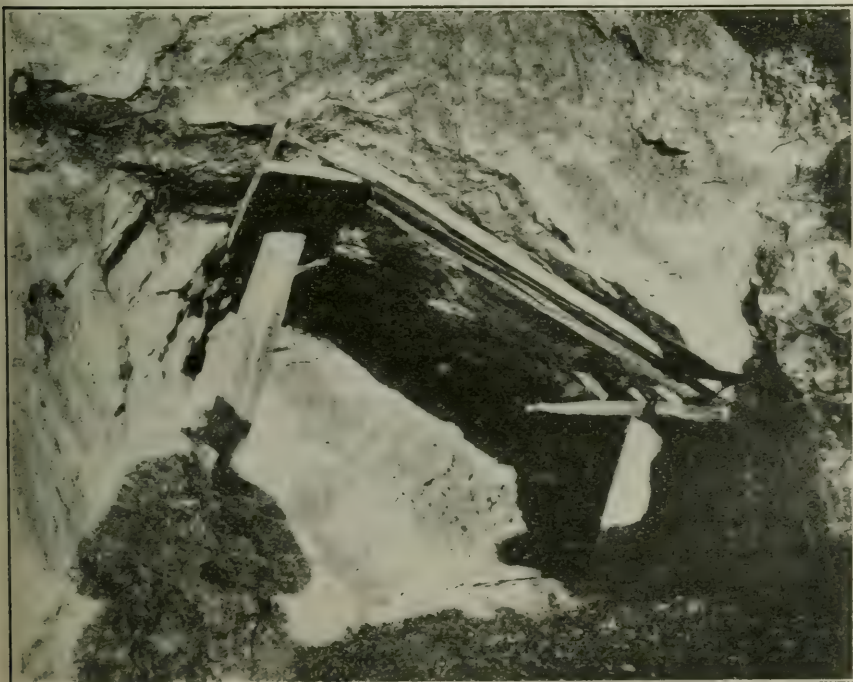


Photo No. 48. Cut in serpentine, from which a small lens (35 tons) of high-grade chromite was taken, at the Grouse Creek Mine, Siskiyou County.

of Grouse Creek with the east fork of Scott River in Sec. 13, T. 40 N., R. 8 W., and Sec. 19, T. 40 N., R. 7 W., M. D. M. Most of the chrome has been found in Sec. 13. It is four miles east of Callahan and 25 miles from the railroad at Gazelle. The chromite occurs in lenses in a serpentized pyroxenite or peridotite. The lenses thus far developed have been small (see Photo No. 48) but of massive, high-grade chromite. Latchem states that some samples have assayed as high as 64% Cr_2O_3 , and that no shipments yet sent out had averaged under 50%. The ore is sacked and sledged a quarter-mile to the wagon road, then two miles in wagons to where the auto trucks pick it up. The mining is done by contract.

Harris Lease. See **Cramer Ranch.**

King Ranch. See **Flederman Leases.**

Lighthill Ranch. See **Flederman Leases.**

Marks Lease. See **Ball Ranch.**

Martin-McKeen Chrome Mine. Hughey Martin and Stewart McKeen, owners; in Sec. 34 (?), T. 40 N., R. 9 W., M. D. M., eight miles from Callahan, on the South Fork of Scott River. This claim was located in 1916, and one carload of ore had been shipped up to June 1st, 1917. The ore was packed on mule-back to a point three miles above Callahan, and then hauled to Gazelle by motor trucks. The ore is high-grade, averaging over 50% Cr_2O_3 . The first orebody at the start of work appeared to be large, but on extraction proved to be a shallow lens lying with the slope of the hill, and yielded only about 30 tons. There were several other 'prospects' not yet developed when visited. The green chrome-garnet, uvarovite, and chrome ochre are associated with the chromite.

Masterson Group. C. J., Joseph, and Mrs. A. C. Masterson, owners, Callahan. This group in Sec. 14 (?) T. 40 N., R. 8 W., M. D. M., is on a branch of the East Fork of Scott River at an elevation between 6000' and 7000' above sea level; and was under snow when the district was visited by the writer in May, 1917. It was located in 1916, and the owners stated their intentions to begin development work as soon as the snow was off. They reported a large outcrop of disseminated chromite ore, with some high-grade material. It is six miles from the main road, but wagons can get to within two miles, where pack mules will be used. Masterson estimates that it will cost at least \$10 per ton to transport the ore to the railroad. C. J. Masterson reports he also has a small prospect at Mountain House, 12 miles from Gazelle, and near the main road.

McCarthy Claims. D. W. McCarthy of Scott Bar reports he has chromite croppings on two claims between Fort Jones and Scott Bar, at 14 and 24 miles, respectively, distant from Fort Jones. Undeveloped.

New Mills. Eugene C. Belknap of Yreka is reported to be considering the erection of a plant for the concentration of low grade chromite ores (May, 1918).

Sharpe Ranch Deposit. See **Flederman Leases.**

Souza Ranch Deposit. Geo. Souza, owner; L. A. Milligan, lessee, Yreka. It is one mile southwest of the post office at Yreka. From small lenses of chromite in serpentine, the lessee had dug out about 10 tons of medium-grade ore from two shallow trenches. No ore had been shipped. Silica appears principally in the form of sericite and a pinkish chromium-chlorite, separating the grains of chromite. These occurrences of chromite near Yreka are in an area of serpentine and peridotite which is from $\frac{1}{2}$ to $\frac{3}{4}$ mile wide and at least seven miles long extending NE.-SW., and passing through the northwestern part of the town of Yreka.

Sugar Creek Chrome Claim. G. H. Cory and Rex Sexton, owners, Callahan; 12 miles northwest from Callahan. A number of small lenses of chromite have been extracted. It is stated that 12 such segregations were required to yield 7200 pounds of ore. A total of 12 tons were shipped in the spring of 1917. When the district was visited by the writer, they were idle, but Sexton was preparing to resume.

The Chrome Mine, Alonzo Bingham, owner, Callahan. This group consists of two claims, in Sec. 12, T. 39 N., R. 9 W., M. D. M., on the ridge between Fox Creek and the South Fork of Scott River, eight miles from Callahan, five miles of which is by trail; elevation, approximately 6000 feet (U. S. G. S.). The locations were made in 1916, and nearly 200 tons of high-grade chromite ore were shipped that year, stated to have analyzed 50%-54% Cr_2O_3 . There are several lenses of chromite in serpentine, the three from which commercial production had so far come being in alignment, but so far as developed not shown to be actually connected. The main open-cut and stope are on the lowest of these (see Photo No. 49). From this lowest lens, considerable chromite float was noted by the writer for some distance down the mountain-side. When visited the stope was 4'x6' wide, with chromite still showing in the face and sides. The chromite is mostly massive and high grade, but there is some disseminated ore on the edge of the lens. Crystals of the green chrome-garnet, uvarovite, occur in some of the fractures in the chromite. There are other lenses nearby not yet developed. The ore

is sacked and packed by mules to the motor-truck road for transportation to the railroad at Gazelle. Transportation costs were \$12 per ton to pack to Callahan and \$5 per ton by motor-truck, 28 miles, Callahan to Gazelle.



Photo No. 49. The Chrome Mine (Bingham Group), main cut and stope, near Callahan, Siskiyou County.

Bingham also has a claim located on a chromite prospect on Sec. 35, T. 40 N., R. 9 W., near the trail to his upper mine.

Valine Ranch Prospect, Antone Valine, owner, Yreka, adjoining the Souza Ranch on the north. T. W. Williamson and Geo. C. Erwin, as lessees, were preparing to start development work at a point where several small bunches of chromite showed in a shallow trench.

Wilson Ranch Prospect. On the Wilson Ranch on Moffit Creek near Fort Jones, Joe Morris and a Mr. Wilson were preparing to develop a chromite prospect.

Wurst Prospect. Wm. Wurst, Callahan, reports he has located chromite a short distance south of Bingham's group described above.

SONOMA COUNTY.

Several deposits of chrome ore occur in a belt of serpentine that strikes northwestward through the western portion of the county. It is along this serpentinized area that some of the large magnesite deposits occur, notably those in the Red Slide district, north of Cazadero. It is reported that a large tonnage of chromite was shipped from the land of the Asti Colony, three miles southwest of Cloverdale, over 20 years ago. This was the only production made until quite recently, when several other deposits were located. These have all proven to be small, and very little chrome ore is now being developed in this county.

Geo. Madeira of Healdsburg, located a deposit of chromite adjoining his magnesite claims in Sec. 31, T. 9 N., R. 10 W., eight miles north of Guerneville. The chromite occurs as small lenses in decomposed serpentine along the summit of a ridge at an elevation of 1400 ft. above sea level. A good road runs within a mile of the deposit which is reached by a trail. About 100 tons of chromite were mined in 1916 from several small superficial kidneys by open cut and trenches. The ore said to assay 34% chromic oxide, is lying on the dumps and no further work has been done. The owner wishes to dispose of this property, which comprises 40 acres.

Meeker Chrome Mine. M. C. Meeker Estate, of Camp Meeker, owner; S. H. Dolbear, Merchants National Bank Bldg., San Francisco, lessee. There are 1400 acres under lease, but the principal development, thus far (July, 1918) has been in Sec. 16, T. 7 N., R. 10 W., M. D. M., 2½ miles W. of N. from Camp Meeker station. There are several lenses of chromite in a belt of serpentine, from one of which Meeker dug out several tons of ore about 30 years ago but made no shipments. The present lessee began operations in November, 1917. Most of these lenses are small, yielding from 5 to 10 tons, so far. The largest one had yielded 150 tons up to July, 1918 (see Photo No. 50), and still showed a face of 4' of ore in the bottom of the stope. A few feet beyond this lens, one of 75 tons had been mined out. The ore assays 39%–40% Cr₂O₃.

The serpentine belt here strikes northwest, and chromite float has been found in at least 50 places, of which 8 or 10 had yielded as much as a wagon-load each.

In addition to the above operations, a hand-jig was used to wash the chromite out of an old dump. A shaft had been sunk at the side of the ravine about 50 feet from the large open cut, and a crosscut was being driven to get under the orebody. There were 12 men, on

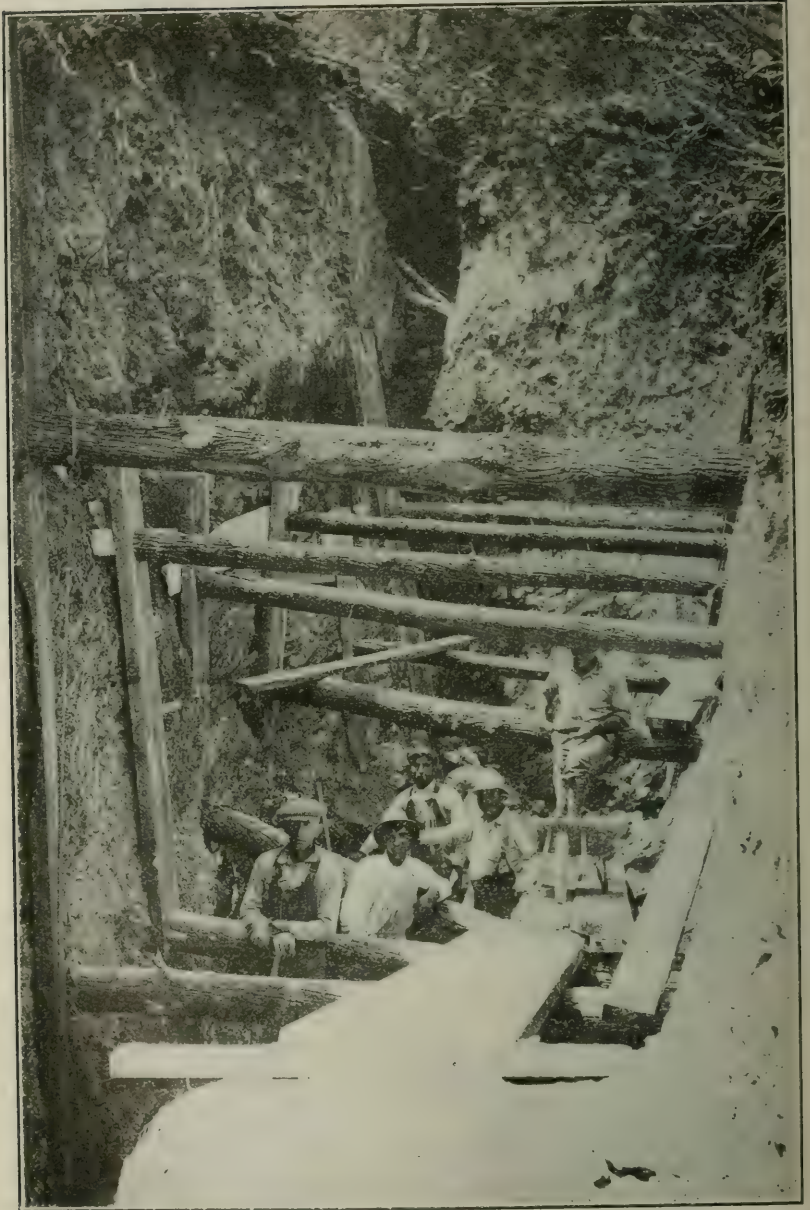


Photo No. 50. Mecker Chrome Mine, near Camp Mecker, Sonoma County, showing open cut and stope. Photo by C. J. Lyser.

one shift, at work. There is plenty of timber at hand for mining purposes.

Parmeter Ranch Deposit. Several small lenses of chromite were developed on this ranch, in 1916 by B. M. Bawman of Cazadero. It is eight miles by road north of Cazadero near the Red Slide. Four carloads of ore, which is reported varied from 38% to 60% chromic oxide, were shipped and the deposits were exhausted.

Shanks and Copps, 1302 Merchants National Bank Bldg., San Francisco, hold a lease on a property in Section 13, T. 10 N., R. 11 W., nine miles west of Geyserville on the ridge north of Skaggs Springs. The ridge is capped with serpentine, in which a few small lenses of chromite have been uncovered. Abundant float occurs along the slopes. Probably 20 tons of fairly high grade ore, that was mined from the several pockets, is lying alongside of the road at the foot of the ridge. No large lenses have been encountered and at the time visited, the property was idle. Miss L. Hallingren of Geyserville is the owner.

The **Wanderer Mining Company**, of 530 Hearst Bldg., San Francisco, is operating the Ardoin chrome mine, between Cloverdale and Asti, west of the Skaggs Springs road. They report (September, 1918) having shipped one carload of ore. This deposit is of chromite boulders in a bed of old river gravels, and is being worked through a shaft. The extent of the deposit is not yet fully determined.

STANISLAUS COUNTY.

Stanislaus County became a producer of chrome ore early in 1916, its existence, up to a short time previous, being unsuspected. A couple of thousand tons have since been shipped out of the county, principally to the plants of the Carnegie Steel Company.

The deposits that are now being developed are situated on the east slopes of the Coast Range Mountains, in the Arroyo del Puerto Cañon, and its branches. The construction of the Patterson and Western Railroad to reach the manganese deposits of the Mineral Products Company* is mainly responsible for the development of these chromite deposits, which, due to their inaccessibility, could not otherwise be mined upon a commercial basis.

The occurrences of chrome ore in this region may be grouped under two heads: (1) Lenses of hard massive black ore, containing little or no serpentine and having a well defined contact with the surrounding serpentine, and, (2) Deposits of gray ore mixed with the serpentine and grading into it.

*See report on manganese deposits, Santa Clara County, p. 76, *ante*; also, general description and map of district, under Alameda County, p. 24, *ante*.

The serpentine belt is fairly extensive here, striking northwestward with the trend of the mountains, and being evidently a continuation of that in which the Cedar Mountain deposits of Alameda County occur.

In this same region are located the Red Mountain magnesite deposits, as well as several old quicksilver mines, namely the Adobe Cañon, Deer Park and Phoenix Mines.

With shipping facilities close at hand, water for mining and milling purposes, available throughout the year in Arroyo del Puerto, and a temperate climate, this region offers considerable inducements to the prospector, and undoubtedly other deposits will be located and developed.

Chrome Concentrating Co. San Francisco office, 501 First National Bank Building. Owners, F. E. Harrison, W. R. Stuck and J. T. Carter.

The mill is located 21 miles west of Patterson near the Patterson and Western N. G. R. R., over which concentrate will be shipped. On March 8, the equipment comprised one 12" Blake crusher, two 5-foot Huntington mills, with 40-mesh screen, a homemade hydraulic classifier and two Overstrom concentrators. Sands and slimes alike were being treated on the Overstrom machines, and some slime losses were being observed, which were to be overcome by the addition of a Dorr thickener and slime table. Only one mill was in operation. This was found capable of crushing one ton an hour when working at 72 revolutions a minute. A 35 h.p. distillate engine furnished power. Ore carrying from 15% to 20% Cr_2O_3 gave a concentrate close to 53%. The owners planned to complete the two units of the plant so that they would have a capacity of 50 tons of ore daily. They anticipated doing custom work for adjacent mines.

Lucky Girl Prospect. It is in Sec. 22, T. 6 S., R. 5 E., one-half mile by trail south of Camp Jones, the terminus of the Patterson and Western Railroad, at an elevation of about 2000 ft., and 500 ft. above Peach Tree Creek, a tributary of the Arroyo del Puerto.

A small open cut exposes an ore body 2 ft. wide and 9 feet high. The ore is high grade, having a sharp contact with the serpentine. Development work had only recently started, so that no ore had been produced. G. L. Fenster of Patterson was doing the development work for the owner, Mrs. Zona Vaughan of Turlock, Cal.

McGuire, Holbrook, and Springer, Crocker Bldg., San Francisco, have a ten-year lease on two chrome claims in Adobe Cañon, about 1000 ft. south of a siding on the Patterson and Western Railroad, 23 miles west of Patterson. Development work started in November, 1916, and

to date over 300 tons of ore, which is reported to have contained over 40% chromic oxide, have been shipped out from one deposit. It occurs in the form of an irregular lens in decomposed serpentine, varying from the heavy gray ore to finely disseminated particles in the serpentine.

This orebody has been developed for a length of 60 ft. by a tunnel, a width of 25 ft. by an open cut and drifts off of the tunnel, and a depth of 40 ft. by a winze sunk in the tunnel near the portal. A few rich pockets were encountered in these workings, and several thousand tons of the low grade ore are exposed. It is said to run from 25% to 30% chromic oxide, not a sufficiently high percentage to be marketed without concentration. Ninety feet below the tunnel, an adit is being driven to cut the lens from below. The shipping ore is hauled in 1-ton cars by a horse to a bunker at the railroad siding. The low grade is not being mined at present, as it is expected to erect a concentration plant in the near future. Water is available for milling purposes in Adobe Creek, below the mine.

Twelve hundred feet southwest of this deposit, a tunnel is being driven to develop a stringer of rich ore, which varies from 1 to 2 feet in width, and appears to lie almost flat. It is now in 30 feet and several tons have been sacked ready for shipment. There is only a narrow trail connecting the two deposits. Six men are employed. J. S. Carter, Patterson, Cal., is superintendent.

Mineral Products Company. A. F. Judd, Honolulu, president, C. G. Bokus, secretary, Robert Anderson, Gen. Manager, home office, Rialto Bldg., San Francisco. This company developed two lenses of massive black chromite that occurred near the top of a ridge 500 ft. in elevation above the Patterson and Western Railroad, at a point 19 miles west of Patterson. Over 1200 tons of chromite were shipped from these two deposits before they were exhausted. Two small deposits are now being mined in the Cañon del Puerto near Camp Jones, yielding several tons daily. They occur in the form of high grade stringers, varying from a few inches to a foot in width. The ore has to be hand sorted. Tunnels are being driven along these stringers and it is possible that they may open out into larger bodies. Other small croppings of chromite occur on the property of the company, which embraces over 5000 acres, but they have not as yet been developed.

J. H. Platner of Patterson is developing a small deposit of chromite in Hide Out Cañon, about $\frac{1}{2}$ mile east of Camp Jones. No ore has been shipped.

TEHAMA COUNTY.

The chrome ore deposits of Tehama County occur in that belt of serpentized peridotite which follows the east slope of the Coast Ranges from north to south throughout the western portion of the county, at elevations which range from 2000 to 4000 ft. above sea level. Access to the several deposits in this mountainous region is gained by several good roads from Red Bluff, the shipping point. The deposits are all located at distances which vary from 25 to 50 miles from the railroad, and are inaccessible during the winter months.

The occurrences of chromite in this region may be grouped under two heads; (1) lenses of hard massive black ore free from serpentine and having a sharp contact with the surrounding country rock, and (2) finely disseminated particles of black chromite in decomposed serpentine.

Chromite was first produced in the county in 1886, and deposits were mined spasmodically up to 1899, the production during that period being over 5000 tons. No further work was done until 1915, when the demands for chrome ore imposed by the war increased its value. Several large deposits are now being developed, and with the successful concentration of the low-grade ores, grouped under the second head, Tehama County should become a dependable producer of this necessary metal for years to come.

S. W. Hill of Red Bluff, Cal., is mining a deposit of chromite, formerly owned by the Tehama Consolidated Chrome Company, in Sec. 16, T. 25 N., R. 7 W. It is situated near the summit of a ridge between the north and south forks of Elder Creek at an elevation of 2800 ft. above sea level, 32 miles by road southwest of Red Bluff. The work is confined to drifting along several narrow high grade lenses of black chromite, exposed in the old workings. There are no large orebodies exposed. Four men are employed and the production varies from 1 to 5 tons daily. The ore is hauled down the mountain-side in a 5-ton Jeffery Quad truck, then transferred to a loading platform, three miles west of the mine to other trucks which haul it to Red Bluff, where it is shipped to the Noble Electric Steel Company's smelter at Heroult.

Bibl.: Cal. State Min. Bur., Reports X, p. 692, XII, p. 38, XIII, p. 50; Bull. 38, p. 272.

Kleinsorge Chrome Mine. This property discovered in 1916, embraces Sections 22 and 27, T. 25 N., R. 7 W., and is 30 miles by road southwest of Red Bluff.

Small crystals of chromite are disseminated throughout a zone of decomposed serpentine, which is approximately one-fourth of a mile wide, extending north and south for two miles along a precipitous ridge that lies at the head of the middle fork of Elder Creek, about one mile south of the Hill and Noble Electric Company's deposits. Numerous samples have been taken throughout the zone, and it is reported that the ore will average over the entire surface area 6% chromic oxide. Occasional pockets or kidneys of massive black chromite are encountered in this zone. Several such deposits are being worked as quarries, and from one there was mined in an open cut 100 tons of ore which is reported to assay 45% chromic oxide. This was piled on the dump awaiting the completion of the 800 ft. aerial tramway, which was being constructed to transport the ore from the upper workings to bunkers alongside of the road.

It is expected to erect a concentration mill in the near future at the tramway terminal to treat the low grade ores.¹ Sufficient water for milling purposes is available throughout the year in the middle fork of Elder Creek. The road to the camp, four miles in length from the main county road at Lowrey, has just been completed and the first shipment of ore was to be made that week. Five ton auto trucks are to be used to haul the ore to Red Bluff.

Mining costs here should be very low, as the work will be done entirely by quarrying and due to the decomposed nature of the ore, very little powder will have to be used. With the erection of the concentration plant, this property will become one of the most important producers of chrome ore in the state. Twenty men are now employed. W. E. Kleinsorge, 605 Peoples Bank Bldg., Sacramento, Cal., is the owner. C. Jerrott is superintendent.

The Noble Electric Steel Company is mining a large deposit of chromite adjoining the Hill deposit in Sec. 16, T. 25 N., R. 7 W. It, too, was formerly the property of the Tehama Consolidated Chrome Company, later being worked by J. A. Heslewood of Oakland, who sold it in November, 1915, to the present operators. The deposit, which occurs as a large irregular lens of high grade chromite in the serpentine, is on the same ridge as the Hill deposit, at an elevation of about 1000 ft. above the north fork of Elder Creek. It is being mined by a large open cut, the face of which is some hundred feet across and from 6 to 30 feet in height, exposing an orebody which varies from 3 to 10 ft. in width. There is a heavy overburden here, which must be stripped

¹This plant is now (August, 1918) in operation.

before mining the chrome, otherwise considerable sorting is necessary. Another orebody, known as the No. 1 working, occurs several hundred feet lower down the ridge. It was from here that most of the chromite was mined by the old company, and only a few small stringers are now exposed in the old workings. Five men are employed, the production varying from 10 to 20 tons daily. The ore is hauled in motor trucks to Red Bluff, under contract by S. W. Hill of Red Bluff. G. A. Eaton is foreman at the mine.

Bibl.: Cal. State Min. Bur., Reports X, p. 692, XII, p. 38, XIII, p. 50; Bull. 38, p. 272.

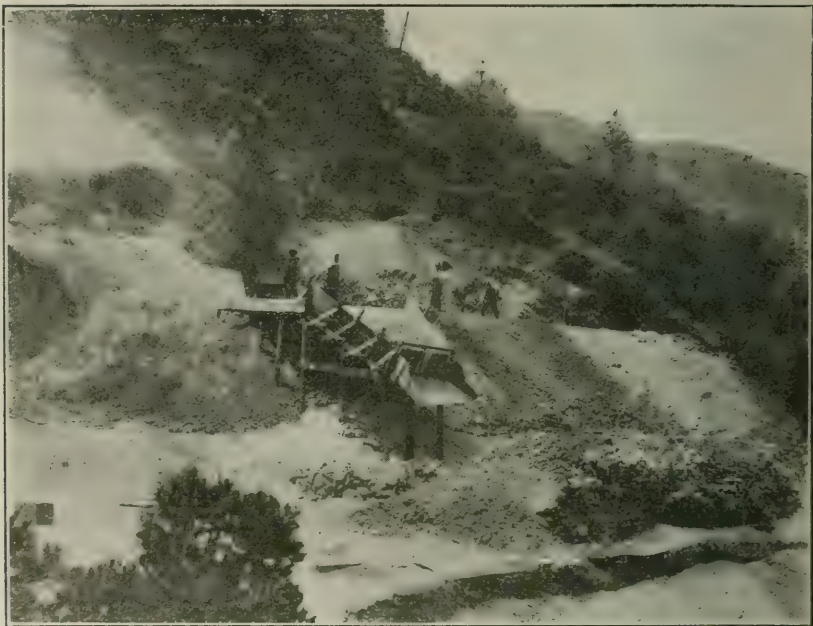


Photo No. 51. Elder Creek Chrome Mine of the Noble Electric Steel Company, Tehama County.

Tedoc Chrome Mine. A group of 20 mineral claims have recently been located to cover some chromite deposits which occur on the slopes of Tedoc Mountain, at an elevation of over 4000 ft. in Sec. 28, T. 28 N., R. 9 W. They occur in the form of lenses of massive black chromite, which is evidently of high grade. Deposits have been found on several of the claims, but very little development work has been done on them. The largest deposit thus far uncovered is on the Mountain View Claim. It appears to be a blanket, extending north and south down the ridge. A series of trenches has been cut across it, showing a width of from

10 to 20 feet, throughout a length of 250 feet. Its thickness or depth has not been determined. The next best showing is on the Dead Pine Claim, which lies to the east of, and adjoining, the Mountain View. Here, two shallow cuts spaced 20 feet apart expose an orebody six feet wide, which appears to be at right angles to the larger body. Small boulders of chromite are found over the slopes on practically all of the claims.

A 12 mile road is being built to reach these deposits, from the Red Bluff-Beegum Road, which will make the haul to the railroad 53 miles. During the summer 50 men were engaged in road building, and the first 5 miles of the new road had been completed. Motor-trucks are to haul the ore to Red Bluff, on a contract basis of \$8.00 per ton. It is expected to start shipments not later than September 15th. The property is owned by the Tedoc Mining Company, under management of Agard and Stewart, 268 Market St., San Francisco. C. H. Philpot is superintendent.

Toms Head Chrome Mine. It is located on the slopes of Toms Head Peak, about midway between the Tedoc Mine on the north, and the Elder Creek mines on the south, 35 miles by road west of Red Bluff. Three to four hundred tons of ore have been mined from a deposit by an open cut, and are lying on the dump. The ore is said to run only 32% chromic oxide, and none has, as yet, been shipped from the property, which is at present idle. J. A. Heslewood, 3908 Randolph Ave., Oakland, is the owner.

TRINITY COUNTY.

In the region from Plummer Spring Ranger Station on the northwest to the headwaters of the South Fork of Trinity River and to Tedoc Mountain there is an extensive occurrence of cherts and associated bodies of serpentine. This area varies from two to six miles wide. Within its boundaries there are a multitude of chromite occurrences.

The largest of these deposits is on Tedoc Mountain and is described elsewhere in this report. A number of small deposits have been worked on the upper course of the Hayfork. In 1916 the Manganese Company of California built about three miles of road through very rocky country to tap some chromite prospects on the upper Hayfork. They took out about 216 tons of ore and have apparently suspended work. The writer observed several such prospects in the area; some were being held without development work and others were open to entry. The district is largely unprospected and little known and while parts of it are remote from transportation there is a possibility that it may be made more

accessible if manganese prospects recently found there come up to expectation. The chromite occurs in the serpentine as a rule in the vicinity of the contact with the surrounding chert.

Crow Creek Group, (also known as the **McConnell-Kirby**, and as the **Chapman-Kirby** claims), Neely Bros., owners, #70 Fremont St., San Francisco. There are several claims in this group in Sec. 14, T. 38 N., R. 6 W., M. D. M., on Crow Creek, a branch of the North Fork of East Fork of Trinity River and 18 miles west of Castella. An 11-mile road to connect with the motor-truck road of the Trinity Asbestos Mining Co., to Castella is now [December, 1917] 70 per cent completed. Development work consists of a number of open cuts and one adit cross-cut. Several lenses of chromite have also been revealed by clearing off the surface soil. In the cross-cut, a face of ore has been opened up 10' wide and 18' high. Some of the chromite is massive and high grade. The green chrome-garnet, uvarovite, is associated with the fracture planes in the chromite. It is estimated that there are at least 2000 tons of 40%-42% ore available. This includes approximately 800 tons already broken and ready to ship as soon as the road is completed, the coming spring. One carload (42 tons) analyzing 44% Cr_2O_3 and 7% SiO_2 was packed five miles to the road, and delivered by truck to the railroad at Castella in December. There is also stated to be apparently a large body of disseminated chromite in these claims, which could be concentrated; and ample water for milling purposes is available. The electric power line of the California-Oregon Power Company to the Coffee Creek dredge passes within two miles of these deposits.

Bibl.: Cal. State Min. Bur., Bull. 38, p. 272; Mines and Min. Res. of Shasta et al. counties, p. 133, 1915; Report XIV, p. 877, 1916.

Dodge Ranch Deposit, Trumbull Bros., owners. A deposit of chromite is reported on this property on the Trinity River, 16 miles from Callahan. Specimens of the ore, shown the writer, appear of good grade.

The **Highland Lake Chrome** property was being worked under the management of Mr. Woolsey of Lamoine. It lies six miles west of the Forest Queen Mine and the ore was being hauled by wagon, 14 miles to Gibson siding. The ore appeared to carry about 50% Cr_2O_3 and was being sold to the Union Chrome Co. of San Francisco.

The **Integral Chrome Mining Company** was preparing to mine chrome on the property of the Integral Quicksilver Mining Company in Sec. 23, T. 38 N., R. 6 W., M. D. M. The owning company consists

of Wm. J. Simpson of New York, and the Anglo-California Trust Company of San Francisco. A ten-year permit to mine chrome on the property is held by J. R. Logan of 400 George St., Vallejo, California.

The property lies on the west slope of Crow Creek 21 miles west of Castella, and consists of 3000 acres, patented. Float chrome assaying over 40% Cr_2O_3 is stated to have been found over an area 50' wide and 2000' long, along an east-west direction. No development work had been done. The property adjoins the Crow Creek group on the south.

Mumbo Creek Group, (formerly **Russell Group**), Mrs. Luella Beauchamp, owner, #591 Turk St., San Francisco. This group of four claims is in Sec. 4 (?) or 11, T. 38 N., R. 6 W., something over a mile north of the Crow Creek group, and about 19 miles from Castella. They will utilize the same road, now under construction. The ore so far exposed is high grade, but only a small amount of development work has been done, as yet.

Phillpot Deposit, C. H. Phillpot, owner, Knob. The owner made some shipments of high-grade chromite in 1916 from a deposit near Hayfork.

Bibl.: Cal. State Min. Bur., Bull. 38, p. 272; Mines and Min. Res. of Shasta et al. counties, p. 133, 1915; Report XIV, p. 877, 1916.

Picayune Lake Group, H. C. Beauchamp, owner, care Columbia Hotel, San Francisco. This group of 14 claims is in Secs. 23, 26, and 27, T. 39 N., R. 6 W., M. D. M., several miles northeast of the Crow Creek Group, and 16 miles southwest from Sisson. Of the latter, 10 miles is by trail. This group was located in July, 1917, covering several outcrops of high-grade chromite.

The Black Jack chrome property located by Wm. Pratti of Peanut, California, lies in south half of Sec. 28, T. 30 N., R. 12 W., at the side of the State Highway, about nine miles from Peanut. A small tonnage of ore was taken from a lens about two feet wide, and was sold in the summer of 1917, since which the property has been idle.

The Compass chrome prospect lies in the southeast quarter of Sec. 21, T. 30 N., R. 12 W., one-quarter a mile from the State Highway and eight miles from Peanut. It is owned by Roy Shiell and Wm. Pratti of Peanut, California. Only a small amount of chromite is exposed and it had not been prospected when visited.

The Eureka chrome prospect is in the N.E. $\frac{1}{4}$ of Sec. 18, T. 30 N., R. 12 W., three miles by trail from the State Highway and nine miles from Peanut. Frank Cummins, owner. This appears to be one of the most promising undeveloped chromite claims in the region. There is an

outcrop $3\frac{1}{2}$ feet wide, apparently in place, showing about 20 tons of shipping ore of a massive character. The outcrop strikes N. 30 W., and there is a good grade of float ore along the strike at intervals for 150 feet. The claim is on a plateau about 1500 feet from the trail, and the grade of the trail to the State Highway is easy and would permit the building of a road at moderate cost. There are other smaller exposures of chromite in the serpentine near this claim, which might develop a small tonnage of ore.

The Peewee chrome claim is near the south corner common to Secs. 21 and 22, T. 30 N., R. 12 W., less than one-half mile from the State Highway and eight miles from Peanut. Roy Shiell and Wm. Pratti, of Peanut, were the original locators. The outcrop shows a lens of chromite of very good grade, four feet wide by twenty feet long; it had been trenched to a depth of one and one-half feet.

The prospect is at an elevation of 4500 feet and is so situated that ore could be hauled from it to the State Highway with very little road building expense. The quality and quantity of ore in sight justifies mining. There was, however, a dispute as to the ownership. The original location notice was defective and the claim was jumped before Shiell and Pratti filed their amended notice.

The Federal Chrome Company, of Red Bluff, is developing some deposits of chromite, near the south fork of Trinity River, in Sec. 33, T. 1 N., and Secs. 4 and 6, T. 1 S., R. 12 W., H. M. This property, consisting of 12 claims, is about midway between Carlotta, on the Northwestern Pacific Railroad, and Red Bluff, being about 65 miles from the railroad at either point.

Seven pockets or lenses of massive black chromite in serpentine have thus far been found, but development work had only just been started in two of them. Probably 30 tons of ore were exposed in each of these, by small open cuts. The pockets appear to be small, and are widely scattered, being from one-half to two miles off of the road. The claims were located in 1916, and only recently taken over by the present owners, who have three men employed. The ore was being hauled in September, 1917, to Red Bluff by auto trucks at a cost of \$13.50 a ton. Florence Brewer, A. S. Dennis and Chas. Scurlock, owners. These claims are situated in a region of heavy snowfall, and the roads are passable for trucks only about five months in the year.

TULARE COUNTY.

Vaughn Ranch Deposit; Vaughn Estate, Porterville, owner. A considerable tonnage of chromite was shipped from lenses on this property, in 1916, and a smaller amount in 1917.

The **Waddell** chrome mine is in Secs. 17 and 20, T. 19 S., R. 27 E., at an elevation of 800', four miles northeast of Lindsay. The property is owned by Frederic Gill of Exeter.

Lenses of chrome, striking in a direction N. 40° E., occurred in serpentine. These had apparently been worked out down to the lower workings.

The property was idle in 1917 save for about 50 tons of ore which had been sorted from the dump, for shipment, by a lessee.

TUOLUMNE COUNTY.

The **Don Pedro** property is in Sec. 6, T. 2 S., R. 14 E., M. D. M., 10 miles southwest of Jamestown. It is owned by the Preston Estate and was leased, for a period of two years, to Levensaler-Speir Corporation. The nearest point on a railroad is Rosasco, one mile west; however, since there is no road to Rosasco, some ore was hauled to Keystone, eight miles northwest, in 1916. Development work consisted of two shafts, one 90' and one 70' deep.

Hughes Group. John, Thomas, Charles and James Hughes, have recently found chromite on their property at Marsh Flat, southeast of Jacksonville, a part of which they are working themselves, and in part leased to others. All told, there are (June, 1918) about 12 leasers operating. Hughes Brothers have so far shipped 2 carloads of chrome ore.

The **Kahl** chrome mine is in the SE. $\frac{1}{4}$ of Sec. 6, T. 1 N., R. 14 E., M. D. M., at an elevation of 1450', six miles west of Jamestown. It is on a 40-acre patent owned by Joseph Kahl of Jamestown.

A lenticular body of chromite occurred, in peridotite, striking N. 40° W. and pitching 80° S. About 400 tons of ore were taken out, in 1915, from a pit 16' deep by 30' wide by 50' long. A small 14" stringer of ore was exposed along the north face of the pit.

Mr. Kahl reports that there are two other small chrome prospects on his property and also one on government land adjoining, which might yield some ore.

C. F. Lighthold and **Geo. Adams** have located claims near the Hughes group, above described.

The **Mackey** property is in the SE. $\frac{1}{4}$ of Sec. 21, T. 1 N., R. 14 E., M. D. M., three miles south of Jamestown. It consists of one claim at

an elevation of 1325', within 50 yards of Woods Creek, owned by Peter Mackey of Jamestown.

Old workings indicate that an orebody 14' wide, 14' deep and 40' long was taken out. Three small open cuts about 4' deep and 6' long had been made. Seventy tons of ore were taken from the open cuts and sold by the owner in 1916.

The **Pereira** property is in the SW. $\frac{1}{4}$ of Sec. 25, T. 1 N., R. 13 E., M. D. M., at an elevation of 1150', three miles north of McCormick siding. It includes 540 acres in claims held by the Pereira Bros. of Jamestown.

Development work consists of open cuts and shallow shafts. About 55 tons of low grade ore, carrying about 24% Cr_2O_3 , had been taken out of an open cut in serpentine. The cut was from 2' to 8' deep and 100' long and had followed the ore in a direction N. 80° E. Work being carried on, during the middle of May, 1917, consisted of opening up several small stringers at a new location about 500' south of the open cut. The ore taken out appeared to carry about 35% Cr_2O_3 , but mining was slow because of the leaders being so small. About 15 tons of this ore were piled for shipment.

The **Rough and Ready** chrome mines are in Sec. 25, T. 1 N., R. 13 E., M. D. M., at an elevation of 1300', about three and one-half miles north of McCormick siding. They are owned and operated by Thos. and Geo. A. Richards of Oakdale.

Lenticular bodies of chrome, in serpentine, strike east-west and pitch 80° North. A 100' open cut, made below the cabin, has exposed a body of ore 10' wide and 50' long which should yield over 60 tons of ore down to a depth of 6'. Analyses of this ore showed 29.9% Cr_2O_3 and 18% SiO_2 , also 26.3% Cr_2O_3 and 12.6% of SiO_2 . On a serpentine hill a quarter of a mile west of the cabin a 25' incline shaft had exposed a lens of ore 4' wide and 6' long which should have yielded a few tons of higher grade ore. An assay of this ore showed 36.7% Cr_2O_3 and 8.8% SiO_2 . About 20 tons of ore were piled for shipment. Two fifty-ton cars of ore were shipped during the middle of May, 1917. Seven men were employed at \$3.00 per day.

The **Sims** property is in the NE. $\frac{1}{4}$ of Sec. 5, T. 1 S., R. 14 E., M. D. M., at an elevation of 1320', about one mile northwest of Chinese. It is owned by Henry Sims of Chinese Camp, and was being worked on royalty by Eglin and Gouge of Jamestown.

Lenticular bodies of chrome ore had been followed to a depth of 25' in serpentine, by an incline shaft. The ore exposed in the bottom of the shaft was 6" wide and struck east-west with possibilities of opening out into another orebody. About 27 tons of ore were corded for shipment, which appeared to average about 40% Cr_2O_3 .

The **Terry** and **Sell** mine is in Sec. 2, T. 1 S., R. 13 E., M. D. M., at an elevation of 1100', about one mile north of McCormick siding. It is on property leased from the McCormick Cattle Company of Sonora.

A 14' shaft has followed a lens of chrome 4' thick and 8' wide, striking N. 35° W. The bottom of the shaft was all in ore when the property was visited on May 18, 1917. Twenty tons of ore had been mined and corded and there was as much more in sight. Old workings, adjoining the shaft, 10' to the northwest, consisted of stopes 3' wide and 30' long, which had been worked from a 65' shaft several years ago.

In addition to the properties above described, **Geo. Mapes** and **J. O'Hara** were stated to be leasing (June, 1918) on the Beckwith land near Chinese Camp. **Henry Kiaupat** had also taken out a few tons from a prospect in the same district. **C. E. Wilcox** of Jamestown, was opening up a chromite deposit on the Stanislaus River, near Burns Ferry, and had shipped one carload of 45% ore. This deposit was exposed by the river wash.

SYNOPSIS OF CHROMITE PROPERTIES IN CALIFORNIA.

Name of property	Owner or operator	Post-office address of owner or operator	Location of property (county)	Section, township and range	Length of haul, railroad shipping point	Tons shipped to date	Tons available not shipped	Active or idle	Development and prospects for production
Mendenhall	E. Mendenhall	Livermore	Alameda						
Newman Mine	McDonnell & Clark	Livermore	Alameda	26-4-3	15 mi. Livermore	1		Active	
Olsen Mine	Ole Olsson	Livermore	Alameda	26-4-3		5		Active	
Carr & Mefford	J. F. Mefford et al.	Ione	Amador	34-6-10	2 mi. Ione	4		Active	
Courtwright	G. Courtwright	Ione	Amador	25-3-10	2 1/2 mi. Ramlett	1		Active	Poor.
Bebert Ranch	W. F. Debert	San Francisco	Amador	6-7-10	8 mi. Carbondale	1		Idle	
Dooley	E. A. Dooley	Plymouth	Amador	Nr. Waits	6 mi. Carbondale	1		Idle	No work since 1916.
Dooley	A. L. Wait	Plymouth	Amador	26-7-10	6 mi. Carbondale	1		Idle	Not stated.
Azard & Stewart	Azard & Stewart	San Francisco	Butte	36-23-4	1 mi. Pulga	6		Active	
Curtis	Cashon's	Magalia	Butte	7-21-4	Oroville	3		Active	
Dowden	G. O. Dowden	Oroville	Butte	15 mi. Blinzig		1		Active	Undeveloped; big prospects.
Hendricks	C. & W. Hendricks	Magalia	Butte	34-22-4	Oroville	1		Idle	
Hendricks No. 2	W. Hendricks	Magalia	Butte	6-21-4	Oroville	1		Idle	
Lambert	A. L. Wakeham	Magalia	Butte	34-23-3	5 mi. Magalia	7		Active	300-500 tons expected.
Lucky Strike	Chas. Park	Woodleaf	Butte	Woodleaf	30 mi. Oroville	4		Active	
Noves	Dickie & Dreisbach	Oakland	Butte	(Chippier Mills)	30 mi. Oroville			Idle	
Robber & McCroskey	A. H. Noyes	San Luis Obispo	Butte	36-23-4	28 mi. Oroville	4		Idle	Surface work—no outlook.
Sharrer	Robber et al.	Big Bar	Butte	16-19-7	30 mi. Oroville			Active	Undeveloped; low grade.
Stokes	D. B. Simmons	Magalia	Butte			1		Active	Good prospects.
Stokes	L. R. Stokes	Yankee Hill	Butte			4		Active	Undeveloped; promising.
Swayne	Swayne Lumber Co.	San Francisco	Butte			4		Active	Good prospects.
Union Chrome	Union Chrome Co.	San Francisco	Butte	35-23-3	19 mi. Chico	1		Active	
Wakebana	Union Chrome Co.	San Francisco	Butte			1		Active	
Wells Mine	Jno. Wells	Yankee Hill	Butte			15		Active	Open cuts—good outlook.
Zenith	Dickie et al.	Oakland	Butte	6-19-7	26 mi. Oroville	1		Active	
Burnham Ranch	Burnham Bros.	Copperopolis	Calaveras	1-13	16 mi. Milton			Active	
Campbell	Mineral Res. Corp.	Calaveras	Calaveras	1-13	16 mi. Milton			Active	
Clary & Langford	Nassau Cop. M. Co.	Angels Camp	Calaveras	10-2-12	8 mi. Angels	9		Idle	Open cut & shaft; no prosp.
Davis	Jno. Davis	Copperopolis	Calaveras	14-2-12	15 mi. Milton	2		Active	Open cut; will prospect.
Dean?	S. P. Dean	Felix	Calaveras		Milton	3		Active	Prospecting.
Hinch	Federal Ore Co.	San Francisco	Calaveras					Active	
Lowry	Hinch	Angels Camp	Calaveras	3-2-12	7 mi. Angels Camp			Active	
McPaul	Geo. C. Lowry	Fosteria	Calaveras	23-5-10	4 mi. Valley Spring			Active	
	J. McPaul	Angels Camp	Calaveras (Copperopolis)		Milton	1		Active	

Peri	F. Peri	Copperopolis	Calaveras	6-143	Milton	1	Active	Very little in sight. Prospects good for 1918.
True Blue	Mrs. E. S. Madrid	Angels Camp	Calaveras	10 mi. Angels Camp	10 mi. Angels Camp	9	Active	
Vogelsgang	D. D. Vogelsgang	Valley Spring	Calaveras	15 mi. Valley Spring	15 mi. Valley Spring	2	Active	
Walker	F. G. Walker	Angels Camp	Calaveras	15-242	4 mi. Milton	1		
Ward	Geo. Ward	Fosteria	Calaveras		Valley Spring	1		Good.
Chrome Wonder	Sam Sites	Stonyford	Colusa	(8 (Stonyford))	28 mi. Fruto			
Innes	F. C. Innes	Willbar Springs	Colusa		25 mi. Williams			All undeveloped prospects at time of report, and no later data obtainable.
Liberty	W. Bradley	Stonyford	Colusa	5-46-6	33 mi. Williams			
Princess	J. J. Sweeney	Sites	Colusa					
Stella	E. & G. Evans	Stonyford	Colusa		25-30 mi. Fruto			No promise of ore.
Teethers	Cy Teathers	Stonyford	Colusa		Grants Pass, Ore.	1		(Expect 1,500 tons, 1918, from these 2 properties.)
Cold Spring	G. W. Gravin	Grants Pass, Or.	Del Norte	35-18-1	15 mi. Crescent City	14	Active	Requires tramway.
Copper Creek	Tyson Estate	Baltimore	Del Norte	5, 6-16-2	18 mi. Crescent City			Expects to pro. 200 tons.
French Hill	J. Hester et al.	Crescent City	Del Norte	21, 28-18-2	22 mi. H. W. & J			Must build tram or rack.
Hawkins	Wm. Hawkins	Crescent City	Del Norte	21-18-2	20 mi. Co. Rail- road			Johns French Hill Mine, west.
High Plateau	H. H. Morrell et al.	Crescent City	Del Norte	30-18-2	20 mi. Crescent City			15 new claims, undevel- oped. Lie 3-18 mi. from end of French Hill road, 18-33 mi. Crescent City.
Malpas	H. Malpas et al.	Crescent City	Del Norte	6-16-2				
Owl	W. L. Childers et al.	Crescent City	Del Norte					
Young and other claims.	Geo. Barton et al.*	Grants Pass, Or.	Del Norte		3-18 mi. from road		Active	
Zarr	F. Zarr	Smith River	Del Norte		Crescent City	1		No more in sight.
Austin	H. C. Austin*	Georgetown	El Dorado	25-13-10	19 mi. Placerville	3		Banded; may produce, 1918.
Bonetti	C. & A. Bonetti	Latrobe	El Dorado	6-8-10	24 mi. Eucendun			Little low grade left.
Brandon	G. & M. Brandon	Latrobe	El Dorado	8-8-9	Flanellis	2	Active	
Bryant	C. Bryant	Latrobe	El Dorado		Folsom	1	Idle	
Burnett Ranch	Noble Elect. Steel Co.	San Francisco	El Dorado		Folsom		Active	50 T. conc. plant being built.
Buzzard	F. Garney	Folsom	El Dorado		Folsom		Active	5-stamp mill for testing.
Cassornal	C. F. Irish & S. P. Co.	Folsom	El Dorado		19 mi. Placerville		Idle	
Chalk	S. Chalk	Latrobe	El Dorado	12, 14-8-9	3 mi. Latrobe	3	Active	
Darrington Ranch. ³	R. L. Dodson	Latrobe	El Dorado				Idle	No more in sight.
Dodson	S. P. Co.	Latrobe	El Dorado	21-11-8	10 mi. Folsom	1	Idle	
Donnelly	Jno. C. Evans	Clarks-vill	El Dorado			2	Active	
Evans	J. C. Forni	Latrobe	El Dorado	8-10	4 mi. Latrobe			
Forni	Freeman	Latrobe	El Dorado	24-8-9	5 mi. Latrobe			
Freeman	P. E. & M. Glenn	Latrobe	El Dorado	14-8-9	2 mi. Latrobe		Idle	
Glenn		Latrobe	El Dorado					

*Lessee.

¹For key to the numbers in this column, which symbolize approximately the production to January, 1918, see last page of this table.²Hollbrook & McClure produce 475 tons from Dean Lease, 6 mi. SE. of Copperopolis, and are now operating a concentrating plant there.³Hollbrook & McClure are operating a concentrating plant on the Darrington Ranch, 8 mi. from Folsom, and are building another plant of 60 tons capacity on same property. Ore run 8 (57% Cr₂O₃); concentrate, 45-52%.

SYNOPSIS OF CHROMITE PROPERTIES IN CALIFORNIA—Continued.

Name of property	Owner or operator	Post-office address of owner or operator	Location of property (county)	Section, township and range	Length of haul, railroad shipping point	Tons shipped to date ¹	Tons available, not shipped	Active or idle	Development and prospects for production
Green	W. C. Green	Georgetown	El Dorado	19-13-11	37 mi. Auburn	2			Tunnel and winze.
Hoff	P. Hoff et al.	Latrobe	El Dorado	30-8-10	5 mi. Latrobe	2			
Irish	American Ref. Co.*	San Francisco	El Dorado	7, 8, 9-10	5 mi. Cummings	2			
Joerger	E. M. Joerger	Oakland	El Dorado	35-10-8	4½ mi. White Rock	1		Idle	
Kelley	M. A. Kelley	Newcastle	El Dorado	16-11-8	6 mi. Newcastle			Idle	98% Cr ₂ O ₃ .
McCurdy	F. A. Cassborn*	Georgetown	El Dorado	8-11-10	10 mi. Placerville	1			
Mundrini	M. Mundrini	Latrobe	El Dorado			1			
Murphy	P. B. Murphy et al.	Latrobe	El Dorado	14-8-9	2 mi. Latrobe				Large body low grade; will concentrate.
Nigger Hill	Noble Elect. Steel Co.	San Francisco	El Dorado		Folsom			Active	See Burnett Ranch.
O'Brien	Jas. O'Brien	Latrobe	El Dorado	18-13-11	36 mi. Auburn	2		Active	Good outlook, 1918.
Ogle	E. C. & W. H. Ogle	Volcanoville	El Dorado			1			Not good outlook.
Pilliken	Geo. Pilliken et al.	Folsom	El Dorado	28-11-8	9 mi. Folsom	16		Active	Sold to Noble E. S. Co.
Pfeiffer	Wm. Pfeiffer	Latrobe	El Dorado	13-8-9	3 mi. Latrobe	1			
Pilot Hill	J. Revoir et al.	Pilot Hill	El Dorado	6-11-9	9 mi. Auburn	2			
Placer Chrome	Placer Chrome Co.	Newcastle	El Dorado	—11-8	8 mi. Newcastle	14		Active	50 T. conc. plant being enlarged to 100 T.
Schelly	L. M. Schelly	Sacramento	El Dorado	5-11-10	16 mi. Placerville				
Simpson	Fleisheln et al.	Folsom	El Dorado	13-10-8					
Steele Ranch	Nettleton & Swanston	Newcastle	El Dorado		Newcastle	1		Active	
Stifle	W. L. Stifle	Georgetown	El Dorado	23-12-10	10 mi. Placerville				
Tropper	Frank Tropper	Greenwood	El Dorado	32-12-10	11 mi. Placerville	2			Prob. bought from Prod.
Wiley	Union Chrome Co.	San Francisco	El Dorado			2			
Zanini	D. E. Wiley	Folsom	El Dorado	11-10-9		1			
Crisle	Zanini Bros.	Latrobe	El Dorado	35-9-9					Too low grade to ship.
Crisle-Riffe	Jno. Crisle	Sanger	Fresno		Sanger	1		Active	Open cuts; 100' shaft; good prospects.
	F. Carson*	Visalia	Fresno		24 mi. Clovis	9			Trying concen., 1918.
Curran	W. E. Curran	Sanger	Fresno		Sanger	3		Active	Poor outlook.
Demasters	S. D. Demasters	Sanger	Fresno		Sanger	1		Active	Shipped from Humphrey, Watt Valley and Piedra.
Doyle	H. S. Doyle	Fresno	Fresno			3			175 T. shipped from locality in 1916.
Franks	J. R. Franks	Piedra	Fresno	25-12-24	6 mi. Piedra				Expects ship 50 T. week in 1918.
Johnston	W. J. Johnston	San Jose	Fresno					Active	

Levensaler	San Francisco	19-11-24	5	Buyers.
Mineral R. Corp.	Fresno	19-11-24	12	No promise of prod.
Moore	Sanger		1	Unsatisfactory outlook.
Rhodes et al.	Coalinga	35-18-12	2	Good prospects.
Snow Mine	Academy		3	Good prospects.
Siebert	Sanger		1	Uncertain outlook.
Snyder	Piedra		1	
Terrill	Trimmet		1	
Vance	Sanger		2	Good outlook.
Watt Valley	H. Vance		13	Clara H. Camden, Rock Wren, Second Thought.
	San Francisco	24± mi. Clovis		
Wood, etc.	Sanger		3	Prospecting.
Black Diamond	San Francisco	18 mi. Fruto	17	
Burrows	Newville		1	
Conklin et al.	Newville	3-22-7	1	
Logan	San Francisco		2	
Luce	Willows		1	
Noyes	A. H. Noyes		4	
Horse Mountain	Horse Mountain		1	Shipping ore.
Copsey	A. Consey et al.		1	
Great Western	Newhall Estate	33-12-7	1	
Harp	Sawyer Tan. Co.*	16-10-7	1	Float ore; no digging.
Lucky Strike	T. F. Fugna et al.	20-11-7	11	Float ore; unpromising.
Thorne	Lew Thorne	24-12-6	5	Nothing in sight.
Tucker	H. Tucker		3	Uncertain prospects.
Evert	Nick Evert		1	Undeveloped prospect.
Purell-Griffin	T. Purell & G. Griffin	--- 5-11	(30)	Large, undev. blanket dep.
Big Red Mountain	100 claims	W3 24-16	(60)	Large, low-grade body.
Graham	W. S. Graham	NW 24-16		Like Big Red Mountain; chiefly float.
Little Red Mountain	G. Kindred et al.		1	Float; 5 mi. from road.
Shields	W. E. Shields	11-23-11	6	Good prospects for 1918.
Chrome C.	H. B. Chase Jr.			
Cigarette	R. Wallace	30-10-5	1	Prospecting work.
Neill	W. H. Neell		1	Poor outlook.
Nicholini	Thos. Neill			
Sullinger	A. Nicholini		1	
Twin Peaks	W. Kilpatrick, Agent.	5 mi. Rutherford	2	
	T. P. Quick M.		4	
Hoelt	Federal Ore Co.			
	Miss F. E. Hoelt			

*Lessee.

For key to the numbers in this column, which symbolize approximately the production to January, 1918, see last page of this table.

SYNOPSIS OF CHROMITE PROPERTIES IN CALIFORNIA—Continued.

Name of property	Owner or operator	Post-office address of owner or operator	Location of property (county)	Section, township and range	Length of haul, railroad shipping point	Tons shipped to date	Tons available, not shipped	Active or idle	Development and prospects for production
Hothersall	Geo. Hothersall	Nevada City	Nevada	13-17-10	22 mi. Nevada City	5	---	Active	Good prospects.
Mount Hill	Geo. Scott	Washington	Nevada	1-17-10	24 mi. Nevada City	1	---	Idle	Apparently exhausted.
Moscattelli No. 1	Bob Moscattelli	Nevada City	Nevada	---	---	1	---	Active	---
Moscattelli No. 2	P. Moscattelli	Washington	Nevada	---	---	1	---	Idle	---
Nevada Co. C. Co.	F. S. Morgan, Mgr.	Nevada City	Nevada	---	---	11	---	Active	10-stamp mill for conc.
Olsen	Olsen Bros.	Washington	Nevada	---	Mill 1 mi. Nev. City	1	---	Idle	No more in sight.
Red Lodge	Williamson Bros.	Nevada City	Nevada	13-17-10	21 mi. Nevada City	9	---	Active	Promising outlook for 1918.
Sweet Ranch	Jno. Sweet	Wolf	Nevada	---	15± mi. Auburn	2	---	Idle	Poor prospect, 1918.
Turtle Dove	W. Niles et al.	Washington	Nevada	1-17-10	23 mi. Nevada City	1	---	Idle	Nothing in sight.
Wolf	Union C. Co.	San Francisco	Nevada	---	---	1	---	Idle	Bought from others (?).
Wolf	H. Thompson	Wolf	Nevada	4-14-8	2 mi. Grass Valley	1	---	Active	Leased; should operate, 1918.
Bugge	C. E. Bugge	Weimar	Placer	---	14 mi. Auburn	1	---	---	---
Bunker	H. H. Bunker	Michigan Bluff	Placer	21-14-11	21 mi. Colfax	3	---	---	---
De Kruse	E. De Kruse	Iowa Hill	Placer	30-15-11	12 mi. Colfax	---	---	---	---
Fiddler's Green	G. Walsh et al.*	East Auburn	Placer	29-13-9	14 mi. Auburn	---	---	---	---
Garrison	E. A. Garrison	Forest Hill	Placer	13-13-9	13 mi. Colfax	1	---	Active	Low grade.
Gas Canon	G. Walsh et al.*	East Auburn	Placer	12-13-9	13 mi. Auburn	2	---	Active	Opening.
Green	Jas. Douths et al.	Westville	Placer	13-13-9	13 mi. Auburn	---	---	---	---
Linder & Hodges	R. E. Linder et al.	Alta	Placer	25-16-10	2 mi. Alta	2	---	Active	Low grade when visited.
Parker	F. W. McNear*	San Francisco	Placer	---	5 mi. Auburn	2	(New)	Active	Poor outlook.
Hogan	Tom Hogan	Grass Valley	Placer	---	---	2	---	Idle	Large body 20% Cr ₂ O ₃ ; 50 T. conc. plant.
Scott	Geo. Scott	Washington	Placer	---	Gorge	2	---	Active	Some ore left.
Schermjoler	H. Schermjoler	Michigan Bluff	Placer	29----	20 mi. Colfax	2	---	Active	(See R. C. Turner.)
Sugar Pine	Power Timber Co.	San Francisco	Placer	31-15-11	27½ mi. Colfax	---	---	---	---
Sullivan	D. J. Sullivan et al.	Dutch Flat	Placer	19-16-11	2 mi. Alta	2	---	Active	---
Turner & Geisendorfer	R. L. Turner et al.	Colfax	Placer	30-15-11	2½ mi. Colfax	11	---	Active	Open cuts; small conc. plant.
Turner	R. C. Turner	Grass Valley	Placer	---	25± mi. Colfax	12	---	Active	Small bunches; good out'k.
Union Chrome Co.	Union Chrome Co.	San Francisco	Placer	---	---	2	---	---	Location not stated.
West	W. W. West	Towle	Placer	---	---	3	---	---	---
Williamson, Co.	W. S. Macey et al.	Iowa Hill	Placer	30, 19-15-11	27 mi. Colfax	2	---	Active	Location not stated.
Zentib	Zentib Chrome Co.	---	Placer	---	---	3	---	---	Location not stated.
Altshuler	Sam'l Altshuler	San Francisco	Plumas	---	---	2	---	---	---

Baldwin	W. T. Baldwin	Oroville	Plumas						Location not stated.
Gold Stripe	Geo. Hall	Greenville	Plumas						Location not stated.
McCarthy	Thos. McCarthy	Quincy	Plumas	14-23-9				Active	{ In limestone (?) ; very inaccessible.
Norris & Noyes	Norris & Noyes	San Francisco	Plumas						Shipping 1 car daily, Nov., 1917.
Valley View	W. P. Boyden et al.	Greenville	Plumas						
Small scattered bodies.			San Benito						Aurora, Tirado Bros. et al.
Alviso and Sunshine	P. A. H. Arata et al.	San Luis Obispo	San Luis Obispo	34-29-12					Prospect only.
Castro	California Chrome Co.*	San Francisco	San Luis Obispo	28-29-12				Active	6,000 T. 20% ore; 50 T. conc. plant.
Chisholm			San Luis Obispo	34-29-12					See Pine Mountain Group.
Chorro Creek	W. C. H. Dibblee et al.	San Francisco	San Luis Obispo	34-29-12					Shallow work; float ore; old producer.
Colorado	G. L. Mott et al.	San Luis Obispo	San Luis Obispo	32-29-12				Active	Shallow work; float ore; old producer.
Cypress	W. C. H. Dibblee et al.	San Luis Obispo	San Luis Obispo	34-29-12					Undeveloped.
El Divisadero	A. A. Wheeler	San Francisco	San Luis Obispo	33-29-12					Old producer; float ore.
El Salto	A. A. Wheeler	San Francisco	San Luis Obispo	33-29-12					Old producer; float ore.
Evans Ranch	Evans Bros.	San Simeon	San Luis Obispo	2-25-6					
Froom	Mrs. Froom	San Luis Obispo	San Luis Obispo						Old producer.
Jobe Ranch	Geo. M. Jobe	San Luis Obispo	San Luis Obispo	2-31-11				Active	Float—undeveloped.
La Primavera			San Luis Obispo						{ 1,000 T. development tunnel and stopes.
La Trinidad	L. H. Butcher Co.*	San Francisco	San Luis Obispo	33-29-12				Active	Small, low grade; undevel.
Lucky Jack	S. Aumaier	San Luis Obispo	San Luis Obispo	20, 31-29-12				Active	
Middlemast	W. C. Middlemast	Cayucos	San Luis Obispo	25-28-10					Undeveloped.
Mutual	P. A. H. Arata et al.	San Luis Obispo	San Luis Obispo	35-29-12				Active	200 T. month.
New London	P. A. H. Arata et al.*	San Luis Obispo	San Luis Obispo	33-29-12				Active	50 T. conc. plant; 15% Cr ₂ O ₃ .
Norcross	Union Chrome Co.*	San Francisco	San Luis Obispo	13-29-11					{ Old production was previous to 1895; 3,000' tunnel; large, high grade.
Parkhurst	H. N. Parkhurst	Pacific Grove	San Luis Obispo						Surface cuts; very promising prospect.
Piek and Shovel	L. H. Butcher Co.*	San Francisco	San Luis Obispo	34, 35-29-12				Active	Surface cuts; good prosp.
Pine Mountain	Mrs. P. Hearst	San Francisco	San Luis Obispo	3, 16-26-8					Undeveloped.
Pereira Group	Mrs. P. Hearst	San Francisco	San Luis Obispo	27-8					
Rancho Piedra Blanca	Mrs. P. Hearst	San Francisco	San Luis Obispo	4-25-7					
Rancho Santa Manuela	T. Steele	Arroyo Grande	San Luis Obispo						
Rancho Santa Rita			San Luis Obispo						
Russ Deposit	A. D. Russ	Arroyo Grande	San Luis Obispo	4-25-6				Active	Old producer.
San Carpolato	F. J. Estrada et al.	Arroyo Grande	San Luis Obispo	12-25-7					Mining, high grade.

* Lessee.

*For key to the numbers in this column, which symbolize approximately the production to January, 1918, see last page of this table.

SYNOPSIS OF CHROMITE PROPERTIES IN CALIFORNIA—Continued.

Name of property	Owner or operator	Post-office address of owner or operator	Location of property (county)	Section, township and range	Length of haul, railroad-shipping point	Tons shipped to date	Tons available, not shipped	Active or idle	Development and prospects for production
Sweetwater	Wm. Hollister*	San Luis Obispo	San Luis Obispo	12-29-11	18 mi. Goldtree	9		Active	1,000 T. dev.; 2-3 ears month.
Welsh Ranch	J. C. Welsh	San Luis Obispo	San Luis Obispo	4-31-11	8 mi. San Luis O.			Active	1 lens opened.
Wheeler	Jas. Wheeler et al.	Santa Margarita	San Luis Obispo		7 mi. Sta. Margarita	1		Idle	Undeveloped; low grade.
Zerfing Ranch	A. L. Zerfing	Cayucos	San Luis Obispo	24-28-10	25 mi. San Luis O.			Idle	Small body mined by E. T. Wear.
Los Olivos	P. B. Montanaro	Los Olivos	Santa Barbara		16 mi. Los Olivos.		(20)	Idle	Slightly prosp. years ago.
La Laguna Rancho	W. H. Bradley	Pasadena	Santa Barbara		12 mi. Los Olivos.			Active	Lot of float chrm.; undeveloped.
O'Donnell-Burns	O'Donnell & B. M. Co.*	Santa Ynez	Santa Barbara		12-15 mi. Los Olivos	3		Active	Expect 1,000 T. 1918.
Jens	Inno. C. Jens	Belmont	Santa Clara		Coyote	1		Active	Small bunches.
Kilday Ranch	M. J. Kilday	Los Gatos	Santa Clara		8 mi. Los Gatos	1		Active	Expect to produce in 1918.
Laurel Lake Ranch	J. A. Ferbrache	Gilroy	Santa Clara		7 mi. Gilroy	1		Active	Several cars shipped.
Winship (Holbrook & McGuire)	K. D. Winship	San Francisco	Santa Clara	{ 11-6-4 } { 7-6-5 }		3		Active	Estimates 1,000 T. left.
Andrews	Asa E. Andrews	Lamoine	Shasta			2		Active	Figure is of total yield.
B. & S.	G. R. Bland et al.	Lamoine	Shasta					Active	
Davis	J. A. Davis	Hazel Creek	Shasta	24-37-5	Sims			Active	
Deick	W. Deick	Hazel Creek	Shasta		Sims			Active	
Forrest Queen	Union Chrome Co.	San Francisco	Shasta	22-37-5	Gibson Sliding	{ 14 } { 1 }		Active	
Gray Eagle	Geo. Grafton	Lamoine	Shasta		8 mi. Lamoine			Active	
Grafton	Mrs. P. A. Hearst	San Francisco	Shasta		Dunsmuir	3		Active	
Hearst	E. K. Hoy	Dunsmuir	Shasta	15-37-5 25-37-5	3 mi. Sims	1		Active	Favorable outlook. See Davis Group.
Hoy Group	California Chrome Co.	San Francisco	Shasta	2-38-4	3 mi. Dunsmuir	{ 15,000 } { tons }		Active	(Total production.) 2d in U. S.; prob. exhausted.
Ida	E. A. Curtis	Hazel Creek	Shasta	13-37-5	Sims			Active	
Little Castle Creek	Wm. Westover et al.	Hazel Creek	Shasta	14, 34-37-5	Sims			Active	
Lone Pine	Fred Miller et al.	Hazel Creek	Shasta		Gibson			Active	
Miles & Westover	Noble Elect. Steel Co.	San Francisco	Shasta	24, 13-37-5	Sims	14		Active	
Miller	P. & C. Sperry	Camptonville	Shasta		Nr. Lamoine			Active	
Noble Electric Steel Co.	W. T. Baldwin et al.	Oroville	Sierra		Oroville	2		Active	
Sherry	Mrs. Bell	Etna Mills	Sierra	29-22-10			(63)	Active	
Camptonville	W. L. Burns	Gazelle	Siskiyou ²	16-41-9	36 mi. Yreka			Active	
Gibsonville	McNulty et al.	Yreka	Siskiyou	16-42-6	4 mi. Gazelle		(45)	Active	
Ball Ranch			Siskiyou		1 mi. Yreka			Active	
Burns Ranch			Siskiyou					Active	
Butcher Hill			Siskiyou					Active	

Cogfins	A. L. Coggins	Dunsmuir	Siskiyou	3 mi. Dunsmuir	12	Remarks
Chastain	Chastain et al.	Gazelle	Siskiyou	14 mi. Yreka	1	
Cramer	C. Harris	Etna Mills	Siskiyou	{ 22-44-8 15-46-11 22-46-11 23-46-11		{ Large, low grade; requires tramway or bridge over Klamath River.
Chromite	J. F. Dwyer	Yreka	Siskiyou	48 mi. Hornbrook		Active
Davis	H. L. Davis	Callahan	Siskiyou	38 mi. Gazelle	3	Active
Dexter Ranch	Geo. Dexter	Montague	Siskiyou	4 mi. Montague		1 car 1917; other cars pre- viously.
Dozler	Noble Elect. Steel Co.*	San Francisco	Siskiyou	12 mi. Gazelle	3	Shaft: new property. Discontinued work.
Facey	H. H. Facey	Callahan	Siskiyou			
Fiederman	A. G. & R. Fiederman	Yreka	Siskiyou	28 mi. Yreka	1	Idle
Fiederman Lease	A. G. & R. Fiederman	Yreka	Siskiyou	15 mi. Yreka	2	
Grant Lease	J. M. Grant*	Etna Mills	Siskiyou	25-42-9 14 mi. Yreka	1	
Grouse Creek	E. C. Latchem	Gazelle	Siskiyou	{ 13-40-8 19-40-7	3	Active
Le May	D. & F. Le May	Yreka	Siskiyou	—44-7	1	O. c. and drift; good prosp. Superficial, small bodies; looks promising. Expects to produce. Undeveloped low grade. Undeveloped low grade. Small surface pockets. Small lenses. Small lenses; nothing in sight, 1918. Chimney, 2'-5' diam.; going down.
Martin-McKeen	H. Martin et al.	Callahan	Siskiyou	34-40-9	1	
Masterson	G. J. Masterson et al.	Callahan	Siskiyou	14-40-8	3	
McCarthy	D. W. McCarthy	Scotts Bar	Siskiyou	32 and 42 mi. Yreka		
Musgrave	H. Musgrave	Yreka	Siskiyou	1 mi. Yreka	1	
Souza Ranch	Geo. Souza	Yreka	Siskiyou	40 mi. Gazelle	1	
Sugar Creek	G. H. Cory et al.	Callahan	Siskiyou			
The Chrome Mine	Alonzo Bingham	Callahan	Siskiyou	12-39-9	3	
Valine Ranch	A. Valine	Yreka	Siskiyou	1½ mi. Yreka		
Wilson Ranch	Wilson	Fort Jones	Siskiyou	29 mi. Yreka		
Wurst	Wm. Wurst	Callahan	Siskiyou	35 mi. Gazelle		
Ardoin	Wanderer M. Co.*	San Francisco	Sonoma	Cloverdale	1	Placer deposit.
Meeker	S. H. Dolbear*	San Francisco	Sonoma	2½ mi. Camp Meeker	4	Still has ore in sight.
Madiera	Geo. Madiera	Healdsburg	Sonoma	8 mi. Guerneville	2	
Parmeter Ranch	B. M. Bawman	Cuzadero	Sonoma	8 mi. Cuzadero	2	Exhausted.

*Lessee.

1For key to the numbers in this column, which symbolize approximately the production to January, 1918, see last page of this table.

2Maltby & Adams of San Francisco bought 165 tons from Siskiyou County producers, not named.

James Patterson of Callahan sold 107 tons from Siskiyou County producers, not named, in 1917.

Union Chrome Co. of San Francisco bought 163 tons from Siskiyou County producers, not named.

C. Strickland and other small producers report 110 tons from scattered properties.

SYNOPSIS OF CHROMITE PROPERTIES IN CALIFORNIA—Concluded.

Name of property	Owner or operator	Post-office address of owner or operator	Location of property (county)	Section, township and range	Length of haul, railroad shipping point	Tons shipped to date	Tons available, not shipped	Active or idle	Development and prospects for production
Shanks	Miss L. Hallingren.	Geyserville	Sonoma	13-10-11	9 mi. Geyserville.	2	---	---	Some float ore and small pockets.
Chrome Conc. Co.	Chrome Conc. Co.	San Francisco	Stanislaus	---	P. & W. R. R. nr. mill	1	---	Active	Mill, 50 T. capacity, being completed.
Hampton	Jno. Hampton et al.	Patterson	Stanislaus	---	P. & W. R. R. nearby	1	---	Active	---
Lucky Girl	Mrs. Z. Vaughan.	Turlock	Stanislaus	22-6-5	1/2 mi. Camp Jones.	2	---	Active	---
McGuire et al.	McGuire et al.	San Francisco	Stanislaus	---	1/4 mi. P. & W. R. R.	5	---	Active	Large amt. 25-37% Cr ₂ O ₃ .
Mineral Products	Mineral Products Co.	San Francisco	Stanislaus	---	Nr. P. & W. R. R.	11	---	Active	Holdings about 5,000 acres.
Platner	J. H. Platner	Patterson	Stanislaus	---	1/2 mi. Camp Jones, on railroad	---	---	---	---
Hill	S. W. Hill	Red Bluff	Tehama ²	16-25-7	32 mi. Red Bluff	5	---	Active	Narrow lenses; high grade.
Kleinsorge	W. E. Kleinsorge	Sacramento	Tehama	22, 27-25-7	30 mi. Red Bluff	5	---	Active	Low grade, 1 mi. x 2 mi. Will concentrate.
Lowrey	Noble Elect. Steel Co.	San Francisco	Tehama	16-25-7	32 mi. Red Bluff	12	---	Active	Large, high grade; 10-20 T. day.
Tedoe	Tedoe Min. Co.	San Francisco	Tehama	28-28-9	53 mi. Red Bluff	7	---	Active	20 claims, undeveloped.
Tom's Head	J. A. Hoslewood	Oakland	Tehama	---	35 mi. Red Bluff	(400)	---	Active	Runs 25% Cr ₂ O ₃ .
Black Jack	Wm. Pratt	Peanut	Trinity	28-30-12	75 mi. Red Bluff	---	---	Idle	Apparently exhausted.
Crow Creek	Neely Bros.	San Francisco	Trinity	14-38-6	18 mi. Castella	11	---	Active	1,000 T. waiting finish of rd.
Compass	Roy Shiel et al.	San Francisco	Trinity	21-30-12	74 mi. Red Bluff	---	---	Idle	Undeveloped prospect.
Dodge Ranch	Trumbull Bros.	Callahan	Trinity	---	16± mi. Delta	---	---	---	---
Eureka	Frank Cummings	---	Trinity	18-30-12	77 mi. Red Bluff	---	---	---	Undeveloped; strong showing good grade.
Federal	Federal Chrome Co.	San Francisco	Trinity	4, 6-1-12	84 mi. Red Bluff	2	---	Idle	Haul costs \$13.50 T.; 5 mo. season.
Highland Lake	Mr. Wooley	Lanaine	Trinity	23-38-6	14 mi. Gilson	---	---	Active	Widely scattered, good grade, float ore.
Integral	Integral Q. M. Co.	San Francisco	Trinity	---	21 mi. Castella	---	---	---	Undeveloped.
Mumbo Creek	Mrs. L. Beauchamp	San Francisco	Trinity	4, 11-38-6	19 mi. Castella	---	---	Idle	Undeveloped; promising; good grade.
Peevec	Roy Shiel et al.	Peanut	Trinity	21, 22-30-12	74 mi. Red Bluff	---	---	---	---
Phillip	C. H. Phillipot.	Knob	Trinity	---	69± mi. Redding	---	---	Idle	Undeveloped.
Pleayune	H. C. Beauchamp	San Francisco	Trinity	26-30-6	16 mi. Sisson	---	---	Idle	Produced in 1916, idle 1917.
Various	Man. Co. of California	San Francisco	Trinity	---	60 mi. Redding	3	---	Idle	on Upper Hayfork.

Owner	Location	Production	Notes	Active	Prospectus
Joyner	Exeter	Tulare	Good prospects.	Active	Good prospects.
Vaughn	Porterville	Tulare	Apparently worked out.	Active	Apparently worked out.
Waddell	Exeter	Tulare	Surface only.	Idle	Surface only.
Beckwith	Jamestown	Tuolumne	Low grade; aband. by Biggs.	Idle	Low grade; aband. by Biggs.
Biggs	Etna Springs	Tuolumne	Surface pits.	Idle	Surface pits.
Cory	Jamestown	Tuolumne	1-90' and 1-70' shaft.	Active	1-90' and 1-70' shaft.
Don Pedro	Jamestown	Tuolumne	Irregular bodies.	Active	Irregular bodies.
Egling et al.	Chinese Camp	Tuolumne	29% to 36%; good outlook.	Active	29% to 36%; good outlook.
Gillis (Madrid)	Tuttletown	Tuolumne	{ 12 leasers, also owners; } { operating. }	Active	{ 12 leasers, also owners; } { operating. }
Hughes Group	Jacksonville	Tuolumne	Good outlook.	Active	Good outlook.
Kahl	Jamestown	Tuolumne	Developing.	Active	Developing.
Lighthold-Adams	Jacksonville	Tuolumne	Expects to mine 50 T. mo.	Active	Expects to mine 50 T. mo.
Mackey	Jamestown	Tuolumne	Promising.	Active	Promising.
McCormick	Sonora	Tuolumne	O. c. and shaft.	Active	O. c. and shaft.
Null	Jno. Null	Tuolumne	Leased.	Active	Leased.
Perelra	W. M. Perelra	Tuolumne		Active	
Perlone	H. Perlone	Tuolumne		Active	
Powell, etc.	G. N. Porter et al.	Tuolumne		Active	
Rough and Ready	Richard Bros.	Tuolumne		Active	
Schoettgen	F. J. Schoettgen	Tuolumne		Active	
Sims	Henry Sims	Tuolumne		Active	
Swerer	A. Swerer et al.	Tuttletown	Abandoned.	Idle	Abandoned.
Terry-Sell	C. W. Terry et al.	Sonora	Plans larger operations.	Active	Plans larger operations.
Various	(See text)	Tuolumne	Shaft; 25% ore.	Idle	Shaft; 25% ore.

*Lessee.

¹Key to figures in column headed "Tons shipped to date".

²Union Chrome Co. bought 43 tons in this county, 1917.

³C. S. Malthy mined and sold a large tonnage from Tehama County in 1916.

1 indicates production under 100 tons.

2 indicates production between 100 and 200 tons.

3 indicates production between 200 and 300 tons.

4 indicates production between 300 and 400 tons.

5 indicates production between 400 and 500 tons.

6 indicates production between 500 and 600 tons.

7 indicates production between 600 and 700 tons.

8 indicates production between 700 and 800 tons.

9 indicates production between 800 and 1,000 tons.

11 indicates production between 1,000 and 1,500 tons.

12 indicates production between 1,500 and 2,000 tons.

13 indicates production between 2,000 and 3,000 tons.

14 indicates production between 3,000 and 4,000 tons.

15 indicates production between 4,000 and 5,000 tons.

16 indicates production between 5,000 and 6,000 tons.

17 indicates production between 6,000 and 7,000 tons.

Prices and Grades of Ore.

The current price for ore ranging from 38% to 48% Cr_2O_3 is from \$1.25 to \$1.50 a unit. (Aug. 17, 1918). Ore containing as little as 28% Cr_2O_3 can be sold. Silica in excess of 8% is often penalized, but by special agreement an ore fairly high in chromite may be saleable even if it carries as much as 15% silica.

Consumers of Chromite.

The following list contains names furnished by the United States Geological Survey, with a few additions:

American Refractories Co.	Pittsburgh, Pa., and Merchants National Bank Bldg., San Francisco
Binney & Smith	81 Fulton St., New York, N. Y.
California Chrome Co.	Kohl Bldg., San Francisco
Carnegie Steel Co.	Pittsburgh, Pa.
Colorado Fuel and Iron Co.	Denver, Colo.
Crucible Steel Co. of America	Pittsburgh, Pa.
A. C. Daft	Oliver Bldg., Pittsburgh, Pa.
Electro-Metallurgical Co.	Niagara Falls, N. Y.
Foote Mineral Co.	107 North 19th St., Philadelphia, Pa.
Harbison-Walker Refractories Co.	Pittsburgh, Pa.
E. J. Lavino & Co.	Bullit Bldg., Philadelphia, Pa.
Lukins Iron and Steel Co.	Seattle, Wash.
A. D. Mackay	130 Pearl St., New York, N. Y.
Metal and Thermit Corporation	120 Broadway, New York, N. Y.
Mutual Chemical Co.	55 John St., New York, N. Y.
National Electrolytic Co.	Niagara Falls, N. Y.
Noble Electric Steel Co.	995 Market St., San Francisco
Otis Steel Co.	Cleveland, Ohio
Pacific Coast Steel Co.	San Francisco, Cal., and Seattle, Wash.
Pacific Electro Metals Co.	Balboa Bldg., San Francisco
Frank Samuel	Harrison Bldg., Philadelphia, Pa.
Sawyer Tanning Co.	Napa, Cal.
Sherwin Williams Co.	Cleveland, Ohio
St. Louis Refractories Co.	Title Guaranty Bldg., St. Louis, Mo.
The Ferro-Alloy Co.	603 Symes Bldg., Denver, Colo.
Younstown Steel and Tube Co.	Youngstown, Pa.

PRODUCTION OF CHROMITE IN CALIFORNIA.

Production of chromite in California began, apparently about 1874, principally in San Luis Obispo County. There was considerable activity from 1880 to 1883, inclusive, and a total of 23,838 tons, valued at \$337,904, was shipped from that county up to 1887.* Some ore also was shipped from the Tyson properties in Del Norte County. The tabulation herewith shows the California output of chromite, annually.

*Logan, C. A., Mines and mineral resources of San Luis Obispo; Cal. State Min. Bur., chapters of State Mineralogist's report, biennial period, 1915-1916, p. 80, 1917.

since 1887, when the compilation of such figures was begun by the State Mining Bureau:

Year	Tons	Value	Year	Tons	Value
1887 -----	3,000	\$40,000	1904 -----	123	\$1,845
1888 -----	1,500	20,000	1905 -----	40	600
1889 -----	2,000	30,000	1906 -----	317	2,859
1890 -----	3,599	53,985	1907 -----	302	6,040
1891 -----	1,372	20,580	1908 -----	350	6,195
1892 -----	1,500	22,500	1909 -----	436	5,309
1893 -----	3,319	49,785	1910 -----	749	9,707
1894 -----	3,680	39,980	1911 -----	935	14,197
1895 -----	1,740	16,795	1912 -----	1,270	11,260
1896 -----	786	7,775	1913 -----	1,180	12,700
1897 -----			1914 -----	1,517	9,434
1898 -----			1915 -----	3,725	38,044
1899 -----			1916 -----	48,943	717,244
1900 -----	140	1,400	1917 -----	52,379	1,130,298
1901 -----	130	1,950			
1902 -----	315	4,725	Totals -----	135,497	\$2,277,557
1903 -----	150	2,250			

SUPPLEMENTARY STATEMENT RELATIVE TO CHROMITE MARKET.

November 1, 1918.

Since the main text of this bulletin was put in type, the chromite situation has undergone a very radical change. The break came late in September, when some of the large Eastern consumers refused to buy ore, claiming a sufficient supply to be on hand, and that they had already taken up their allotments permitted by the War Industries Board. This came 'like a thunderbolt out of a clear sky' to the Western producers who had been most strongly urged as "a patriotic duty to mine chrome, on account of its military necessity and shortage in available domestic supplies."

Following this there ensued a series of telegrams and other correspondence between Western producers, on the one hand, and the Eastern consumers and War Industries Board, on the other. The producers appealed to the Governmental agencies for relief.

Two telegrams, quoted herewith, from the War Industries Board to Mr. Albert Burch, their representative in California, reveal the situation as it now stands:

"It is the present intention of the War Industries Board to arrange for continued chromite production in the United States for the first half of 1919 at a rate proportionate to the rate of 1918 production, and the trade will be asked to purchase chromite of suitable grade produced in the United States during the first half of next year at this rate. We believe the tonnage of domestic chromite produced the balance of this

year of suitable grade can be sold at the average price paid this summer by the California Chrome Co. If unable to find ready market for ore, wire this office, giving tonnages ready for immediate delivery and guaranteed analysis and prices wanted, and to whom already offered and refused.

Signed: HUGH W. SANFORD, Chief,
Chemicals Division, Ferro-Alloys Section,
War Industries Board, Washington, D. C., Sept. 27."

Telegram Sent by the War Industries Board to Mr. Albert Burch, Crocker Building, San Francisco, Special Representative of the U. S. Bureau of Mines, Regarding Chrome Production on the Pacific Coast.
(Published in San Francisco Chronicle, Nov. 1, 1918.)

"Referring my telegram September 27, which you had published. This seems to have caused misconception in minds of some chromite purchasers who have interpreted this telegram to mean that the Government was guaranteeing not only full consumption of chromite for balance of this year and first half of next year, but also that the guarantee was for sales during either or both periods at the price prevailing during the summer of 1918. This interpretation can not properly be gotten from the language of the telegram. In order to clear up any misconception please have this complete telegram published. The War Industries Board does not at this time guarantee any sales of chromite for balance of this year or the first half 1919 at any prices. The War Industries Board has asked chromite users to buy as much domestic chromite as possible during the remainder of this year and may decide to request buyers to purchase domestic chromite for the first half of 1919 on some new price basis. It is impossible to say how fully the buyers will co-operate with such requests. Stocks in hands of users are large, particularly stocks in hands of users of high-grade ores, these stocks probably averaging ten to twelve months' supply. The over-supply of chromite today is due more to decreased domestic consumption than any other one factor, the domestic consumption being about 35,000 tons less than anticipated for 1918. This is due chiefly to the recent changes that have been made in the industries for the necessities of the war programme, such as reduction in manufacture of automobiles, which industry formerly absorbed large quantities of ferrochrome and also the use of less chrome tanning in the leather trade on account of vegetable tanned shoes being used largely in the Army for trench work. A programme has been recommended to the War Trades Board by the War Industries Board for a reduction of imports from all countries to the lowest practicable minimum and their decision will probably be announced in a few days. The War Industries Board has also removed all restrictions on conservation of use of chromite and is not denying proper exports of chrome products. Serious consideration is being given by all Governmental departments to this problem but at present it is doubtful whether additional aid can be given to the domestic chromite situation beyond the procedure stated above. If any further developments will advise you.

Signed: HUGH W. SANFORD."

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